SoLID baffle update

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2013/05/17

Babar magnet and Babar baffle

- It is in the original proposal and preCDR
- The label is wrong. It should be 50uA 85% polarized 11GeV beam on 40cm LD2 for 120 days

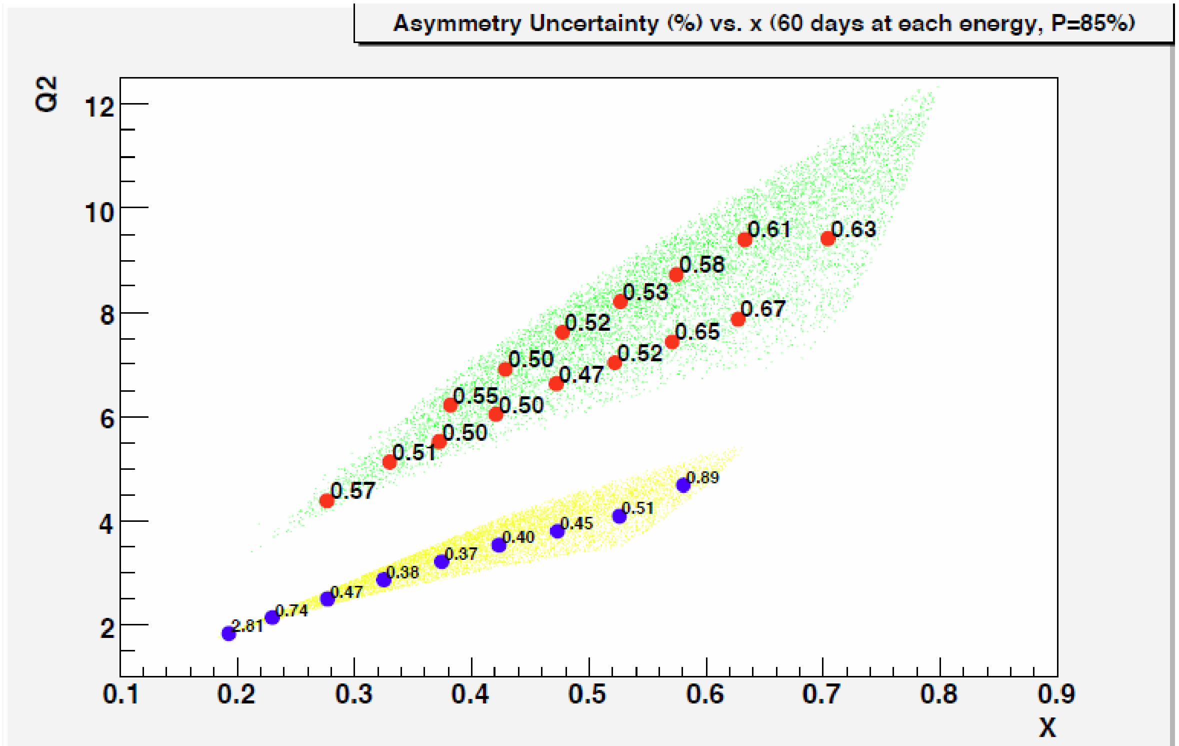


Figure 4: Anticipated statistical precision for Solid

CLEO magnet and larger Z baffle by Seamus

0.27,0.39,0.43,0.60,0.48,0.55,0.52,0.59,0.62,0.61,0.78,0.67,0.82,0.71,0.72

larger Z baffle
Seamus simulation

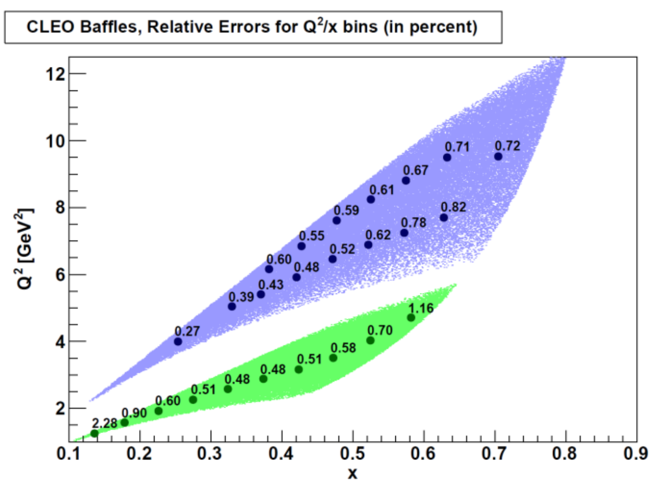
0.20,0.28,0.39,0.36,0.45,0.38,0.48,0.44,0.57,0.49,0.74,0.57,0.81,0.62,0.65

larger Z baffle
Zhiwen simulation

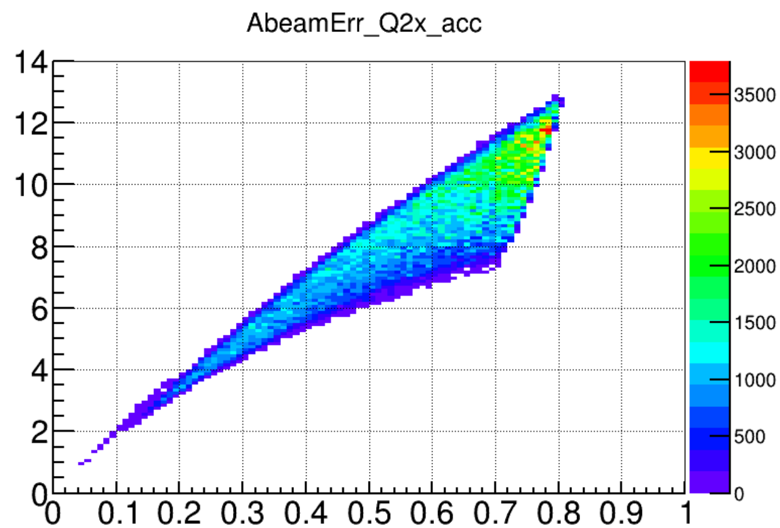
The binning should be same as Babar previous plot used

Zhiwen's result having a little better error bar could be due to

1. Seamus used smaller than what-should-be luminosity?
2. Zhiwen define acceptance as detected by EC (Z=320cm,r=118-261cm), Seamus might do it slightly different?



larger Z baffle
Seamus simulation



larger Z baffle
Zhiwen simulation

CLEO magnet and
larger Z baffle by Seamus and smaller Z baffle by Zhiwen

0.20,0.28,0.39,0.36,0.45,0.38,0.48,0.44,0.57,0.49,0.74,0.57,0.81,0.62,0.65

larger Z baffle
Zhiwen simulation

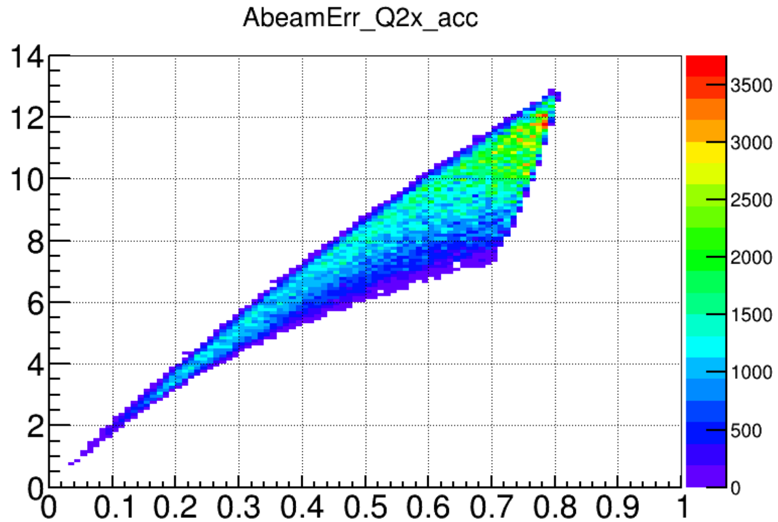
0.18,0.27,0.43,0.34,0.48,0.35,0.51,0.42,0.62,0.47,0.81,0.56,0.90,0.62,0.68

Smaller Z baffle
Zhiwen simulation

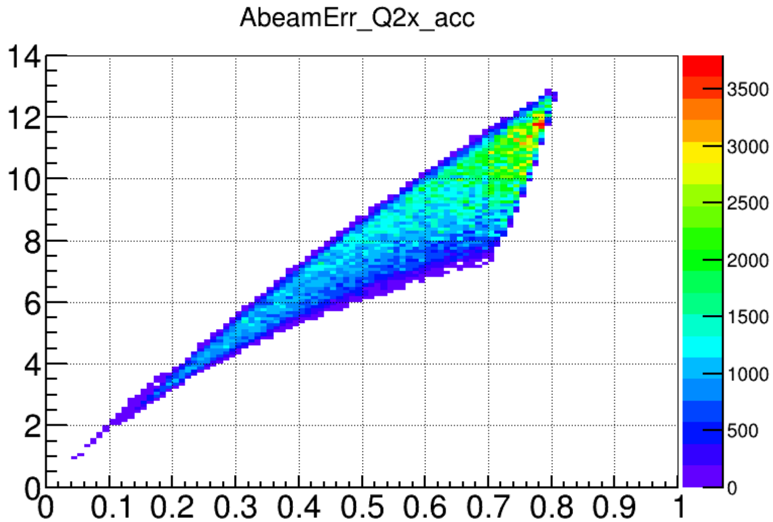
The binning should be same as Babar previous plot used
The result are similar

Smaller Z baffle
Zhiwen simulation
Optimized binning

0.17,0.24,0.36,0.38,0.42,0.39,0.48,0.44,0.56,0.51,0.66,0.64,0.75,0.70,0.67
This is from Smaller Z baffle with optimized binning



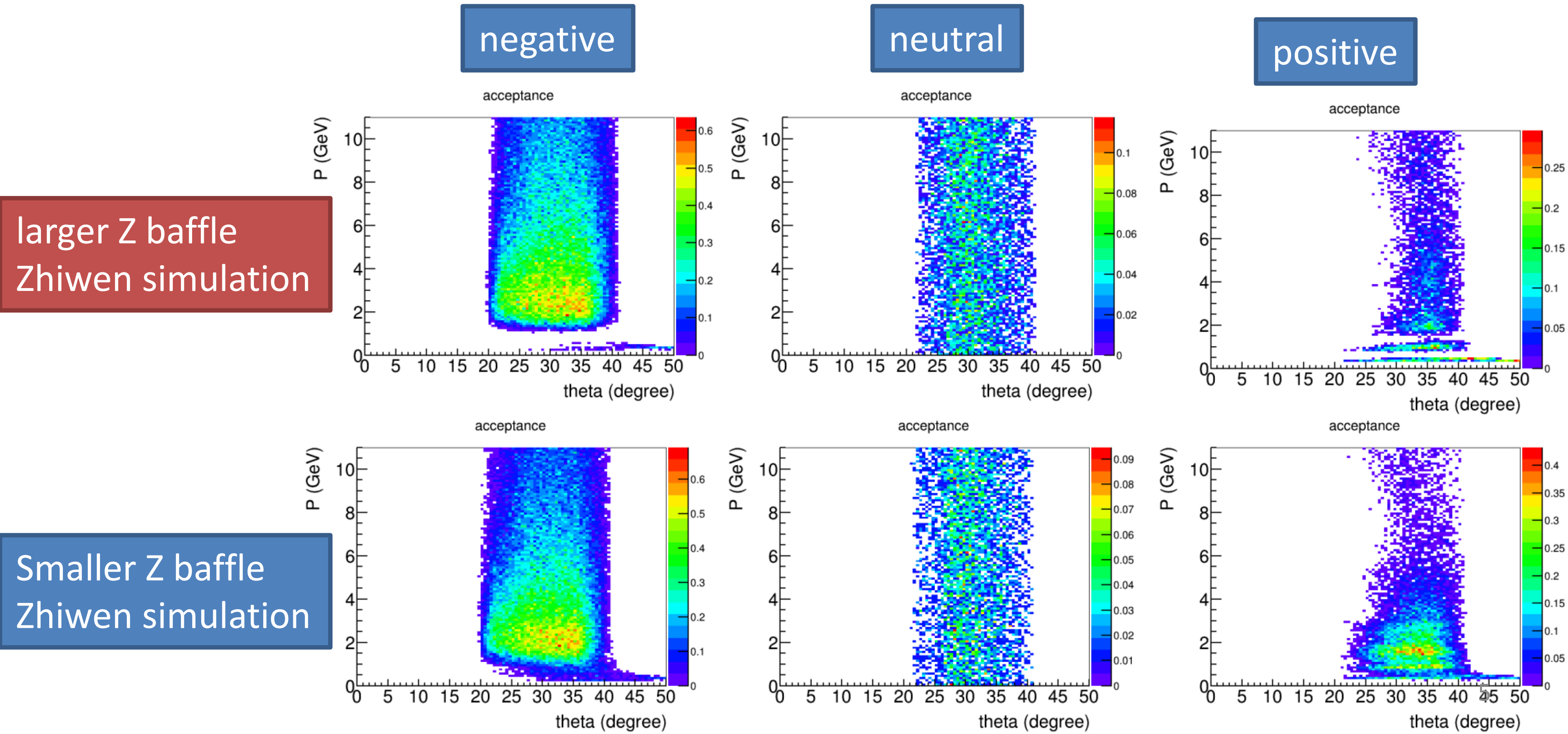
Smaller Z baffle
Zhiwen simulation



larger Z baffle
Zhiwen simulation

Compare general acceptance

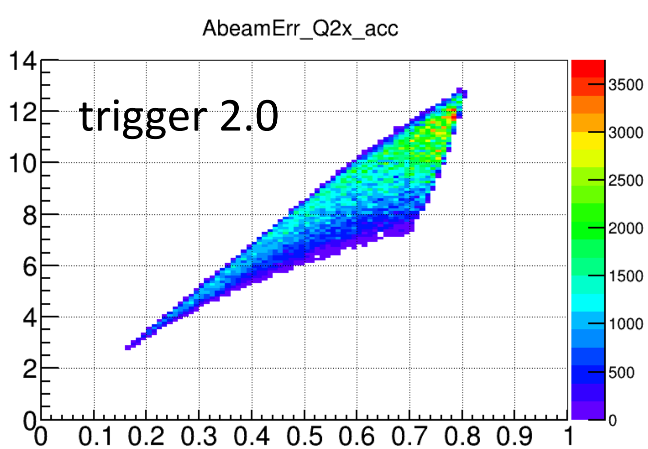
- Smaller Z baffle has more lowE negative acceptance
- Neutral acceptance are similar
- Smaller Z baffle has almost double positive lowE leak
- The impact on GEM and EC needs to be checked

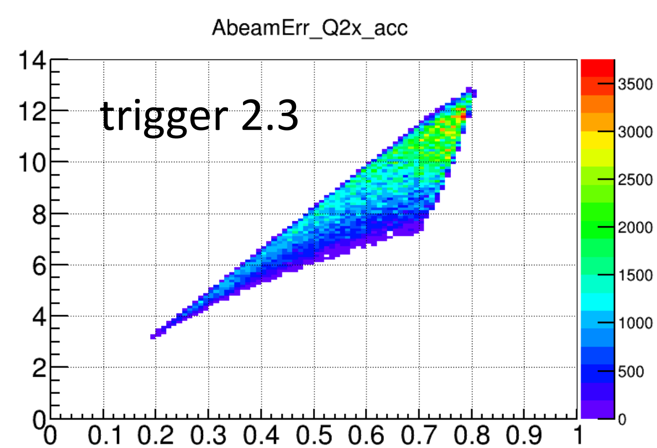


Trigger effect
of smaller Z baffle

ApvErr	trigger (GeV)
0.17,0.24,0.36,0.38,0.42,0.39,0.48,0.44,0.56,0.51,0.66,0.64,0.75,0.70,0.67	0.0
0.20,0.26,0.36,0.40,0.42,0.40,0.48,0.44,0.56,0.51,0.66,0.64,0.75,0.70,0.67	1.5
0.27,0.31,0.37,0.62,0.45,0.51,0.48,0.51,0.56,0.54,0.66,0.65,0.75,0.70,0.67	2.0
0.38,0.37,0.39,0.96,0.42,0.74,0.48,0.65,0.56,0.65,0.66,0.75,0.75,0.74,0.67	2.3
0.53,0.43,0.43,1.46,0.44,1.03,0.48,0.86,0.56,0.80,0.66,0.89,0.75,0.83,0.69	2.5
2.13,0.84,0.63,0.00,0.56,9.22,0.56,2.83,0.60,2.14,0.68,1.97,0.75,1.40,0.81	3.0

ApvErr at large Q2 and large x starts to increase if trigger > 2GeV

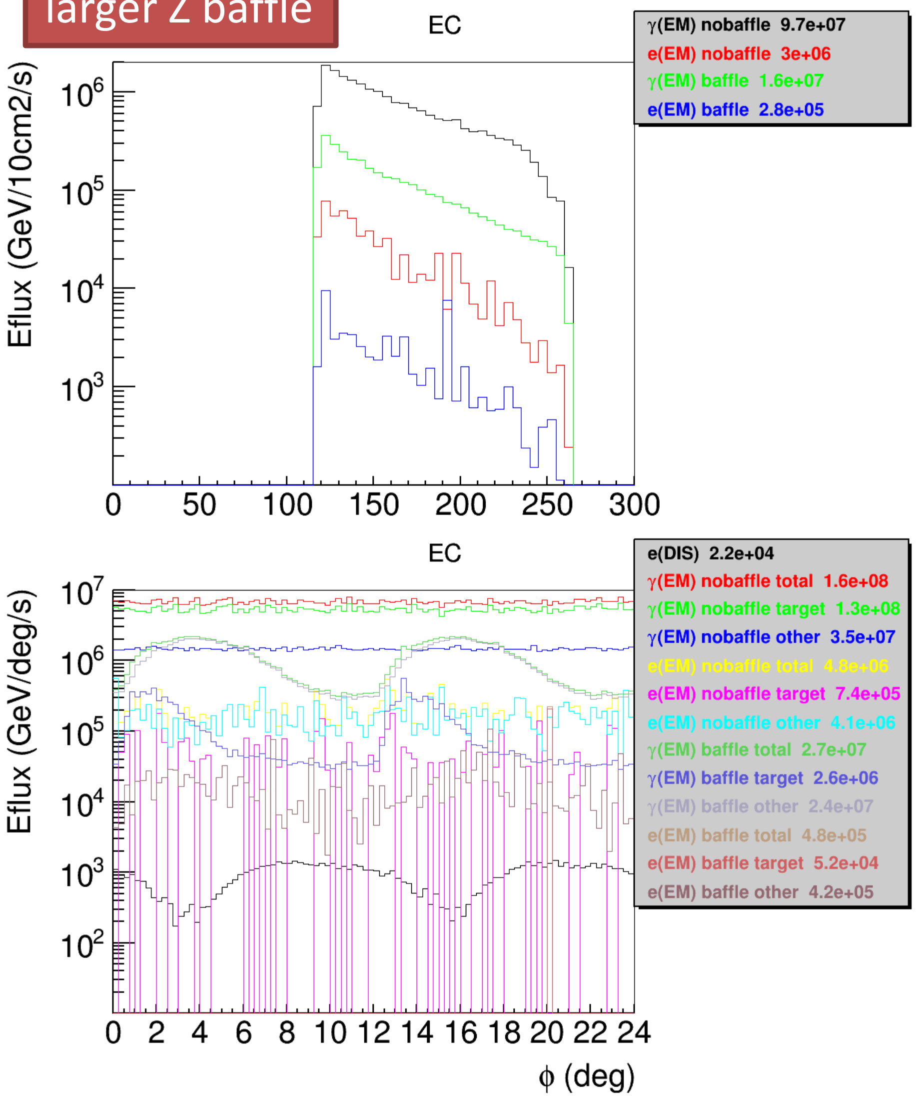




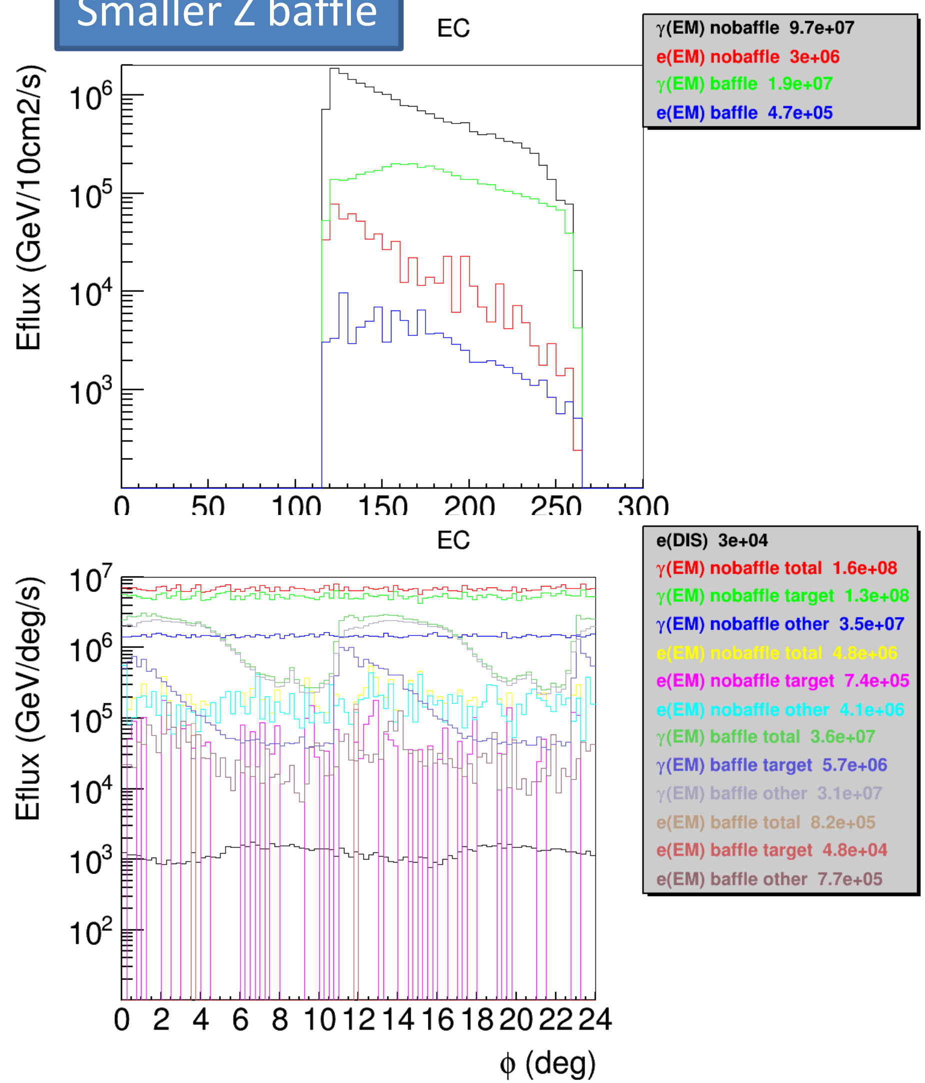
EM Background on EC

- Green lines in R plot show smaller Z baffle has lower photon background at inner radius than larger Z baffle

larger Z baffle



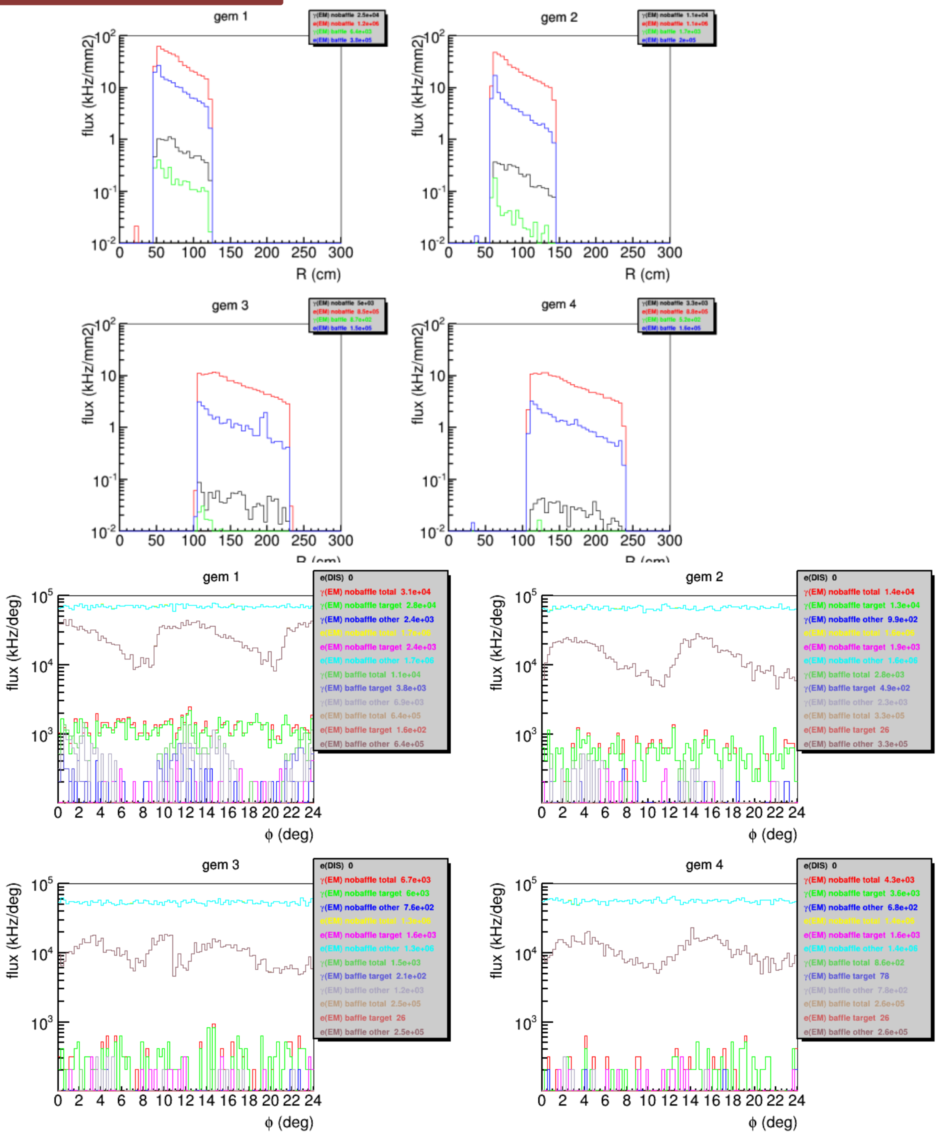
Smaller Z baffle



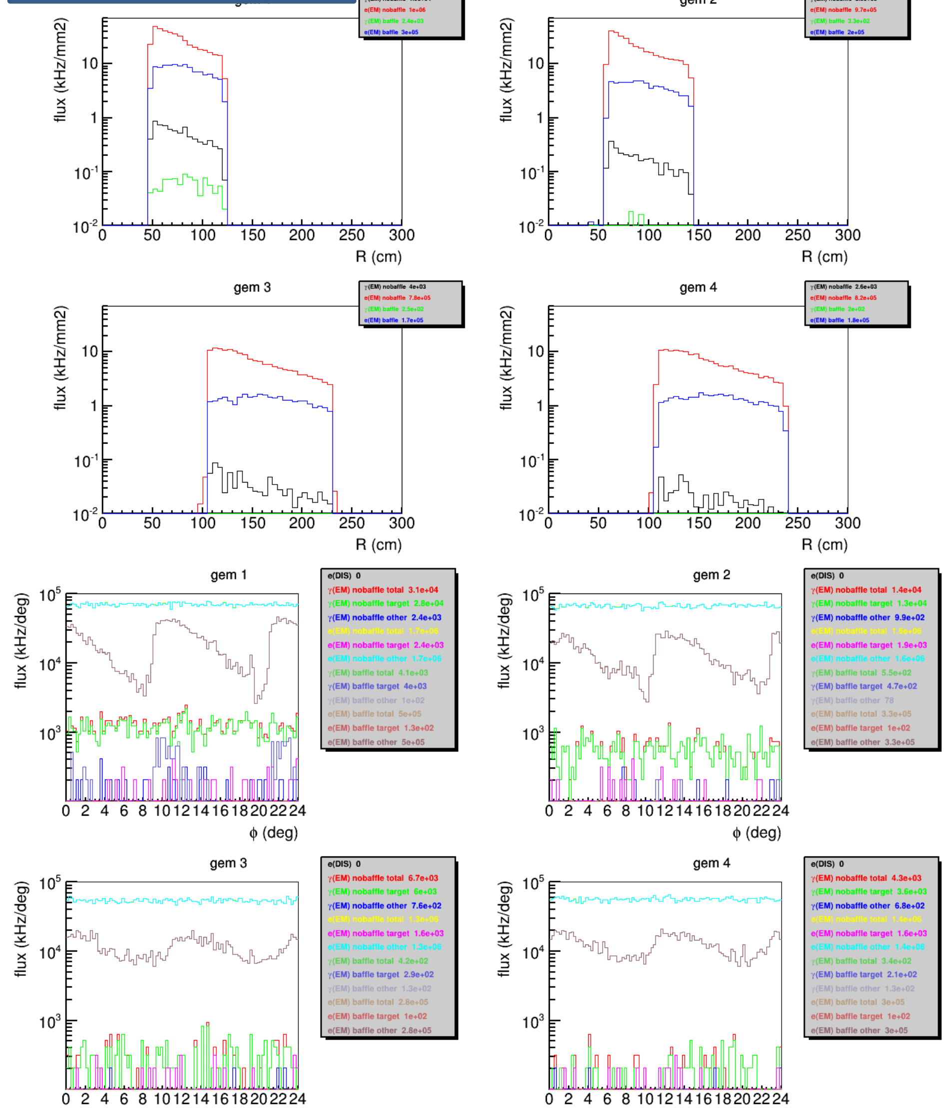
EM Background on GEM

- Blue lines show smaller Z baffle has lower electron background (10kHz/mm2) at inner radius than larger Z baffle (20kHz/mm2)

larger Z baffle

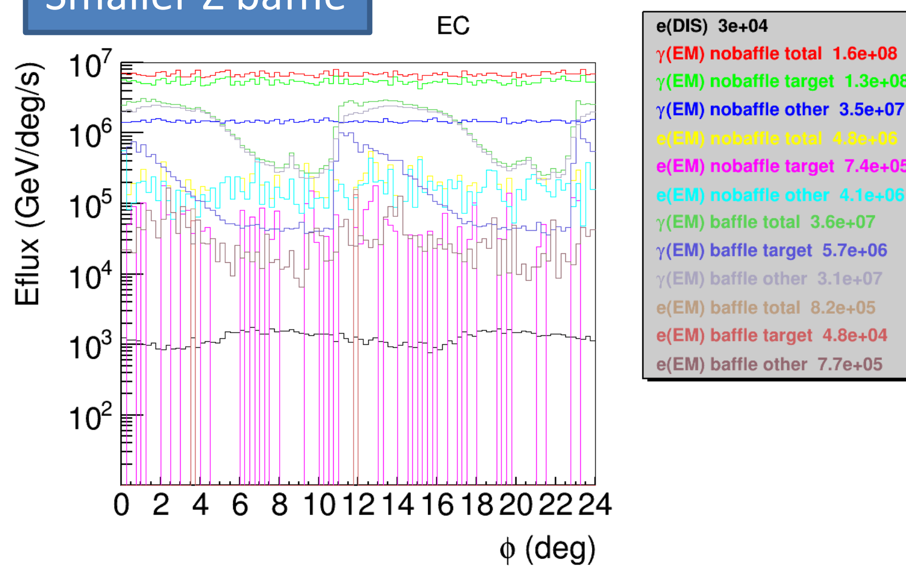


Smaller Z baffle



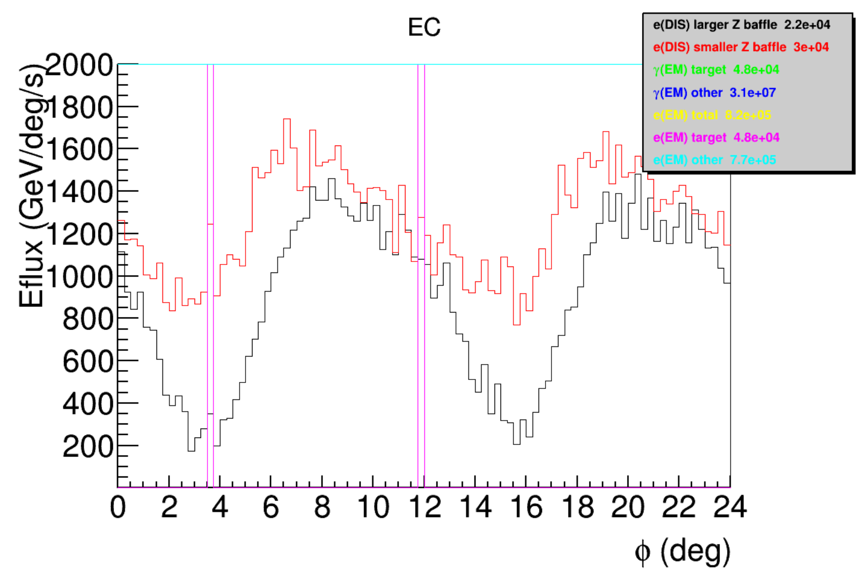
eDIS pattern in Phi on EC

Smaller Z baffle



eDIS on EC has different patter in Phi from photon background

Can this feature be used to help EC design?



eDIS on EC, Smaller Z baffle has less variation than larger Z baffle

Conclusion

- Smaller Z baffle has similar acceptance of eDIS event like larger Z baffle and can satisfy the physics requirement
- Its effect on EC and GEM need to be evaluated to see if further tweaking is needed

- More background plots
  - Smaller Z baffle
    - http://hallaweb.jlab.org/12GeV/SoLID/download/baffle/baffle_smallerZ_plot
  - Larger Z baffle
    - http://hallaweb.jlab.org/12GeV/SoLID/download/baffle/baffle_largerZ_extrablock

Remaining questions

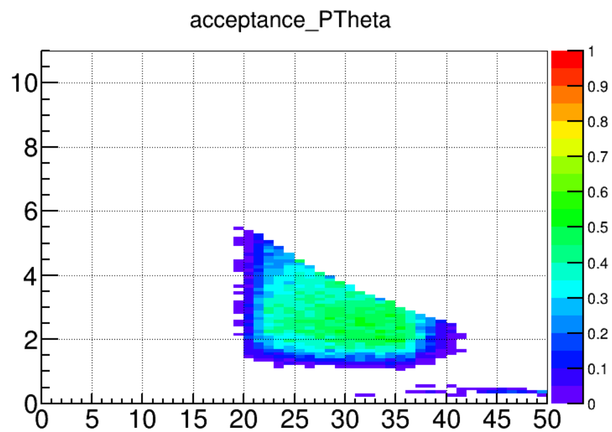
- How much error we should on ApvErr estimation?
  - ApvErr very much depends on

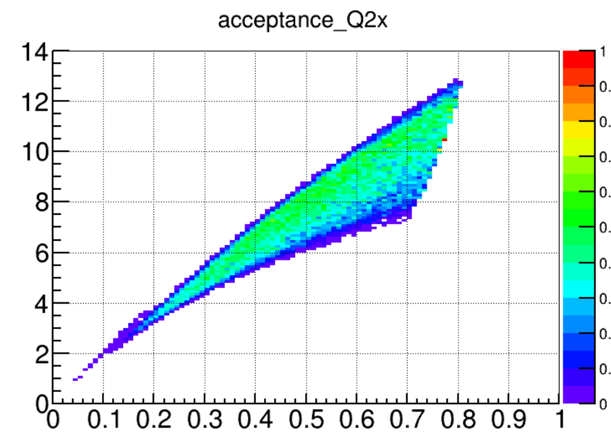
    1. eDIS rate
       - “rate” from the event generator eicRate, it’s based on the PDG formula with structure function from CTEQ
    2. Apv
       - “Abeam” from eicRate
- How sensitive is the baffle to raster size, alignment, field change, etc?

Compare eDIS acceptance

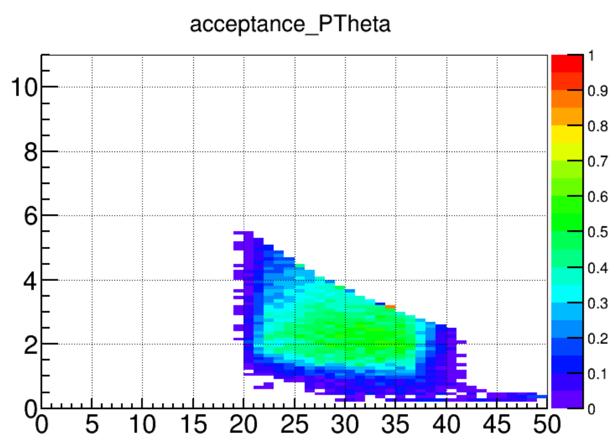
- eDIS acceptance are similar which leads to similar ApvErr

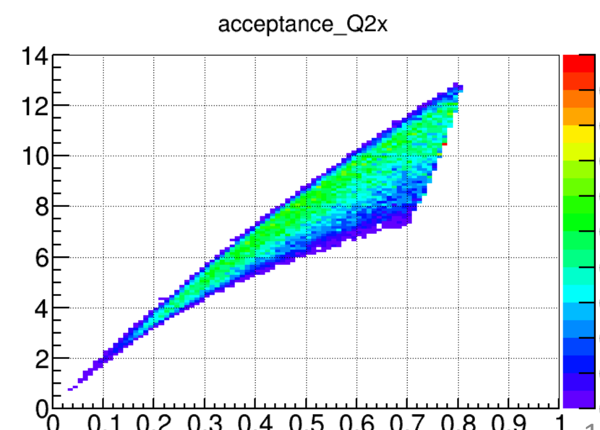
larger Z baffle
Zhiwen simulation





Smaller Z baffle
Zhiwen simulation





Zhiwen simulation detail

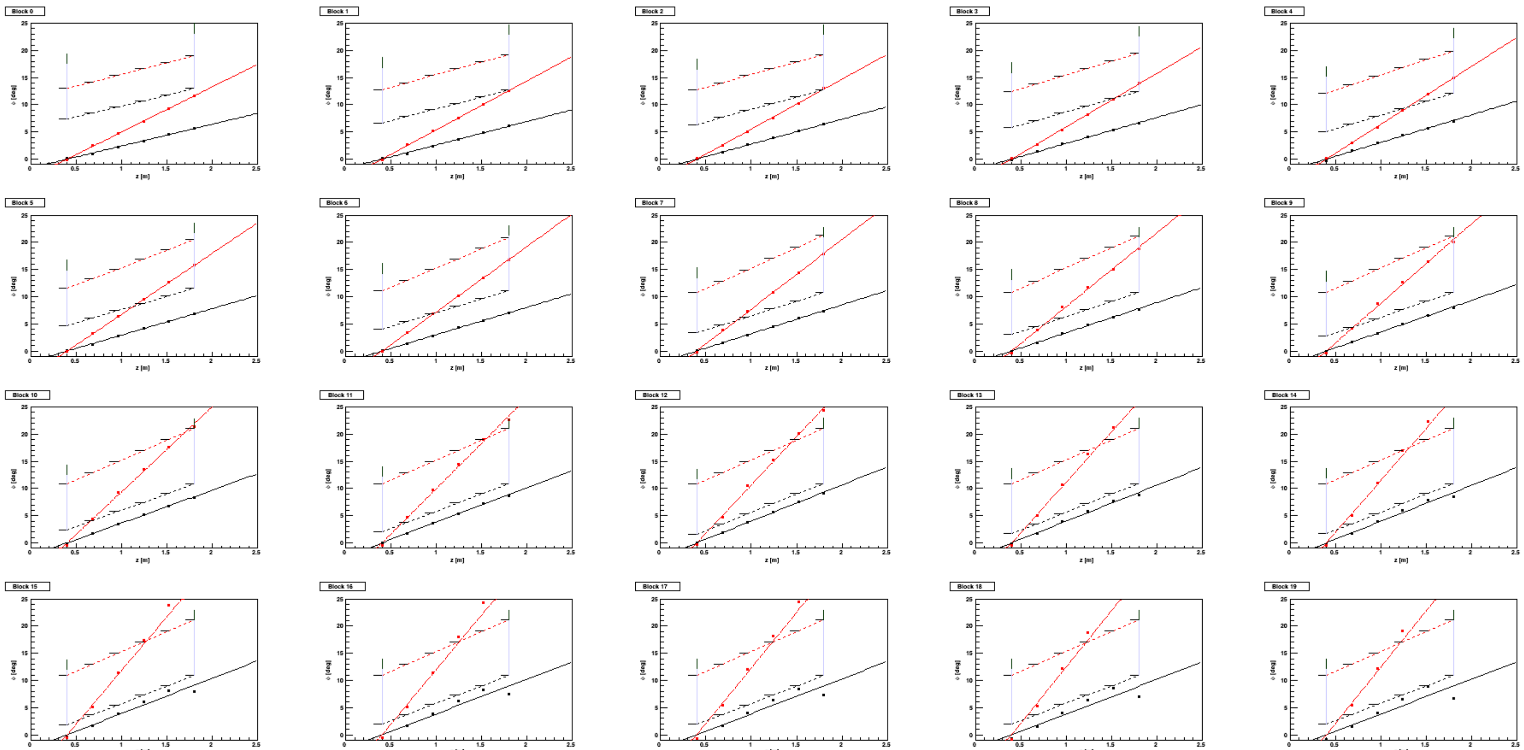
- DIS electron on 40cm LD2 target with 5mmx5mm raster and nuclei Lumi 0.63e39/cm2/s from eicRate, then apply W<2GeV cut
- Use GEMC 1.7 and CLEOv8 field map
- ApvErr= 1/sqrt(Sum(rate*acc*time)/Apv_acc_ave/Pb*100
  - Average of Apv of accepted events in a bin, Apv_acc_ave= Sum(Abeam*rate*acc)/Sum(rate*acc)
  - beam polarization, Pb = 0.85
  - 120 days running, time = 120*24*3600
- No event by event fitting for Apv (Does this matter much?)

Design Detail

- Common
  - use SoLID CLEOv8 field map
  - 30 sectors with each sector covering 12 deg
  - Still each plate is 9cm thick of lead
  - SCALE MIN=1.4, MAX=1.4, LASTBAF=0. in makebaf5.C
- Larger Z baffle only
  - Z (40, 70, 100, 130, 160, 190) cm
    - overlap with Cherenkov and leaves no room for GEM
  - Rin (3.90, 15.30, 26.60, 37.90, 49.20, 61.01)cm
  - Rout (41.31, 62.32, 83.32, 104.33, 125.34, 142.00)cm
    - Not optimized for polar angle 21-36 deg acceptance of full 40cm long target with center at 10cm
- Smaller Z baffle only
  - Z (40, 68, 96, 124, 152, 180) cm
    - no overlap with current setup
  - Rin (2.11, 12.86, 23.61, 34.36, 45.10, 55.85)cm
  - Rout (39.60, 59.94, 80.28, 100.63, 120.97, 141.31)cm
    - Optimized for polar angle 21-36 deg acceptance of full 40cm long target with center at 10cm

Design approach
from larger Z baffle to smaller Z baffle

- Continue with Seamus's approach
  - In simulation, throw negative particles from target position with field, record tracks at different position
  - Then do linear fitting to figure out what kind of blocking should be at the assumed baffle plates position.
  - Output the opening (not block)
  - refer to
    - https://hallaweb.jlab.org/wiki/index.php/Baffle_Design
    - https://hallaweb.jlab.org/wiki/index.php/Solid_design_FOM
- Fix a bug of detector plane position in the input file
- Change Z, Rin, Rout to the desired values



backup

Eugene’s baffle has about 2 times better acceptance at higher P

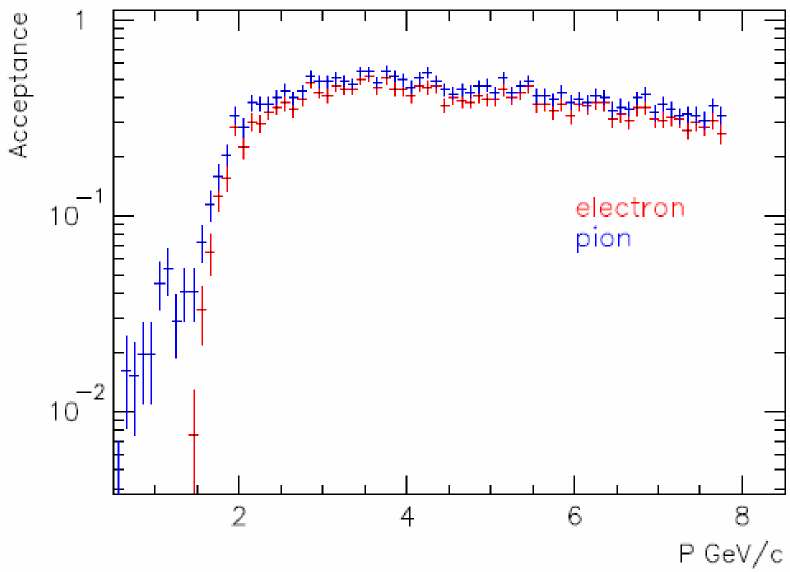


Figure 3.8: The acceptance dependence on the particle momentum for electrons and pions. The baffles reject electrons with $p < 1.5$ GeV, while pions below 1.5 GeV are reduced by a factor of 20-50.

- Original PVDIS design with small endcap and BaBar coil, the field reached 1.5T
- Currently we have larger endcap to accommodate SIDIS and CLEO coil, the field reaches 1.4T
- It could be a better design or just with stronger field(?)

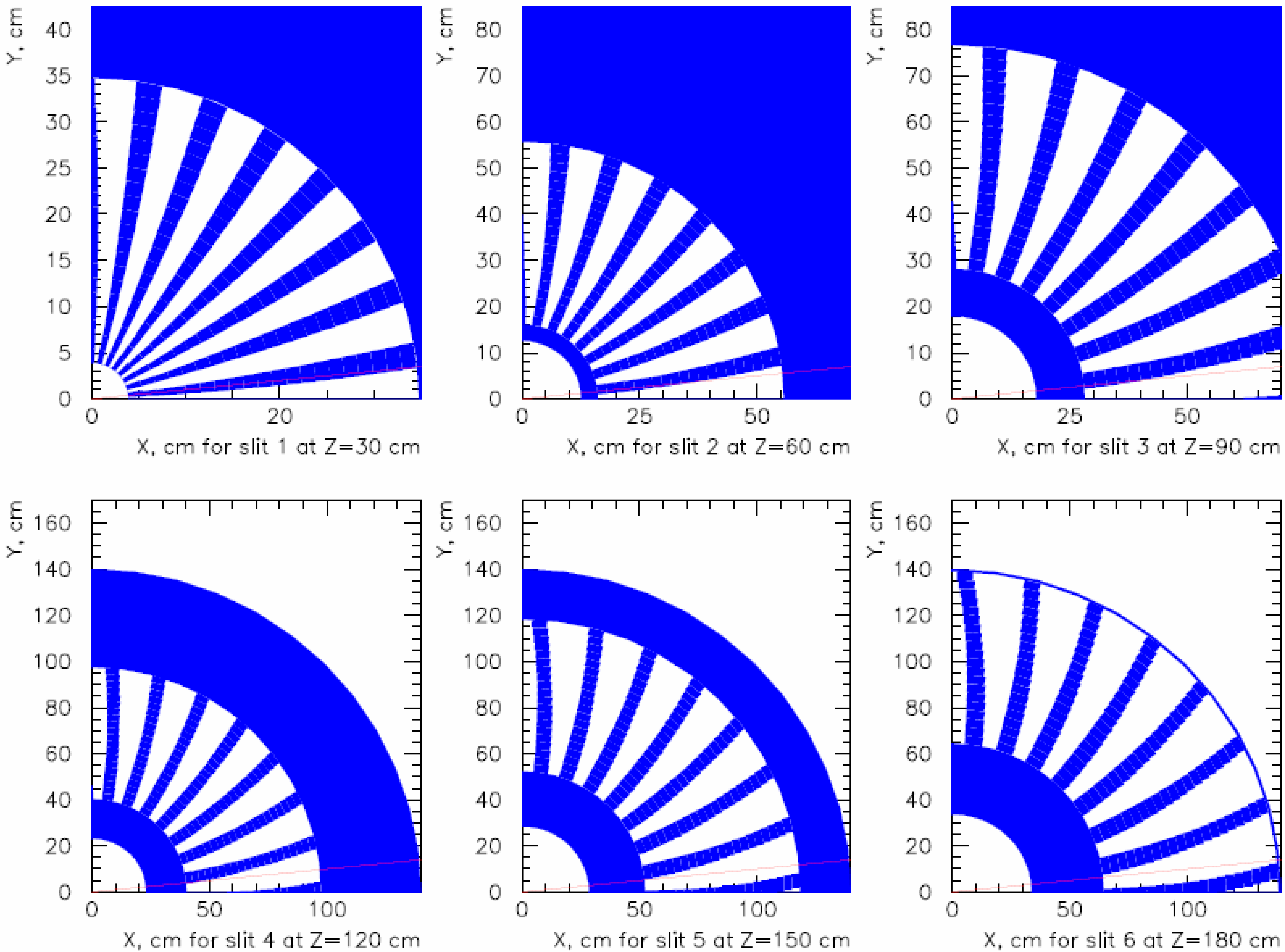


Figure 3.7: The optimized geometry of the baffles.

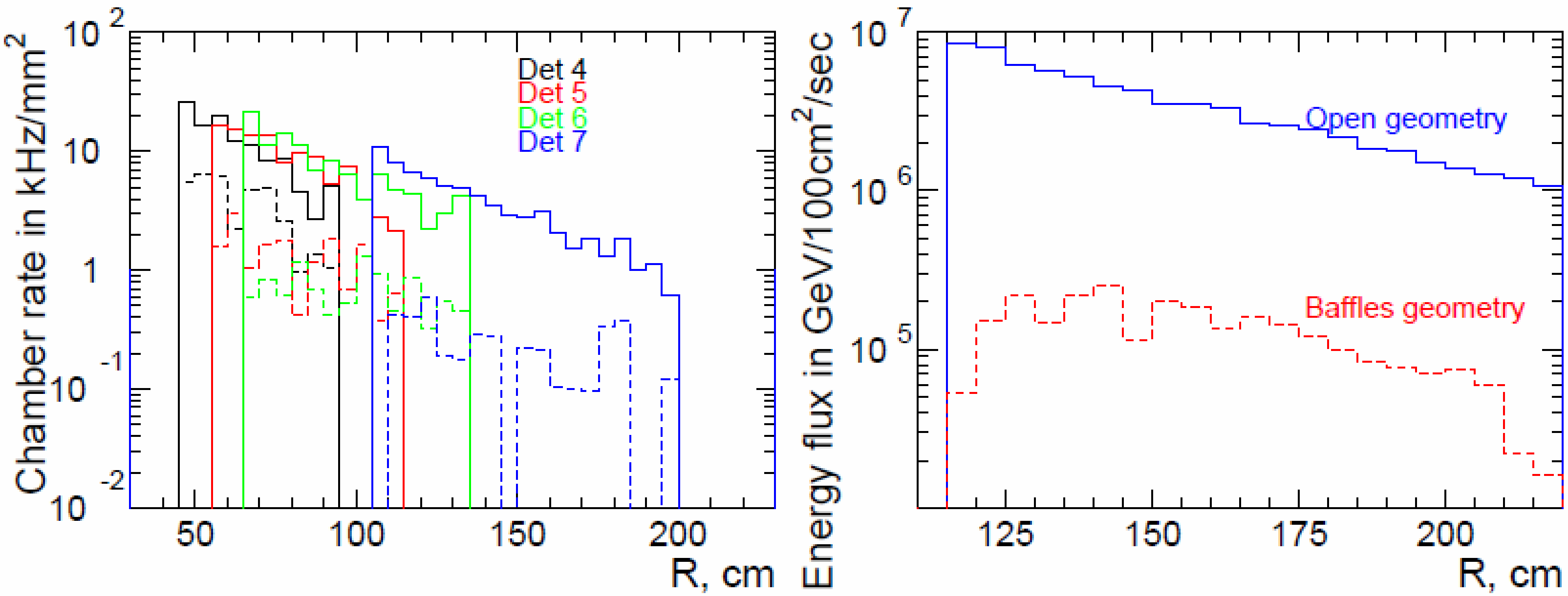


Figure 3.9: Left: the background rate in the coordinate detectors in kHz per mm^2, depending on the radius, without the baffles (the solid lines) and with the baffles (dashed lines). The baffles reduce the rate by a factor of ~10 for the detectors 5-8. Right: the energy flow in the EM calorimeter in GeV/100cm^2/s, without baffles and with them. The baffles reduce the rate by a factor of 15-50.

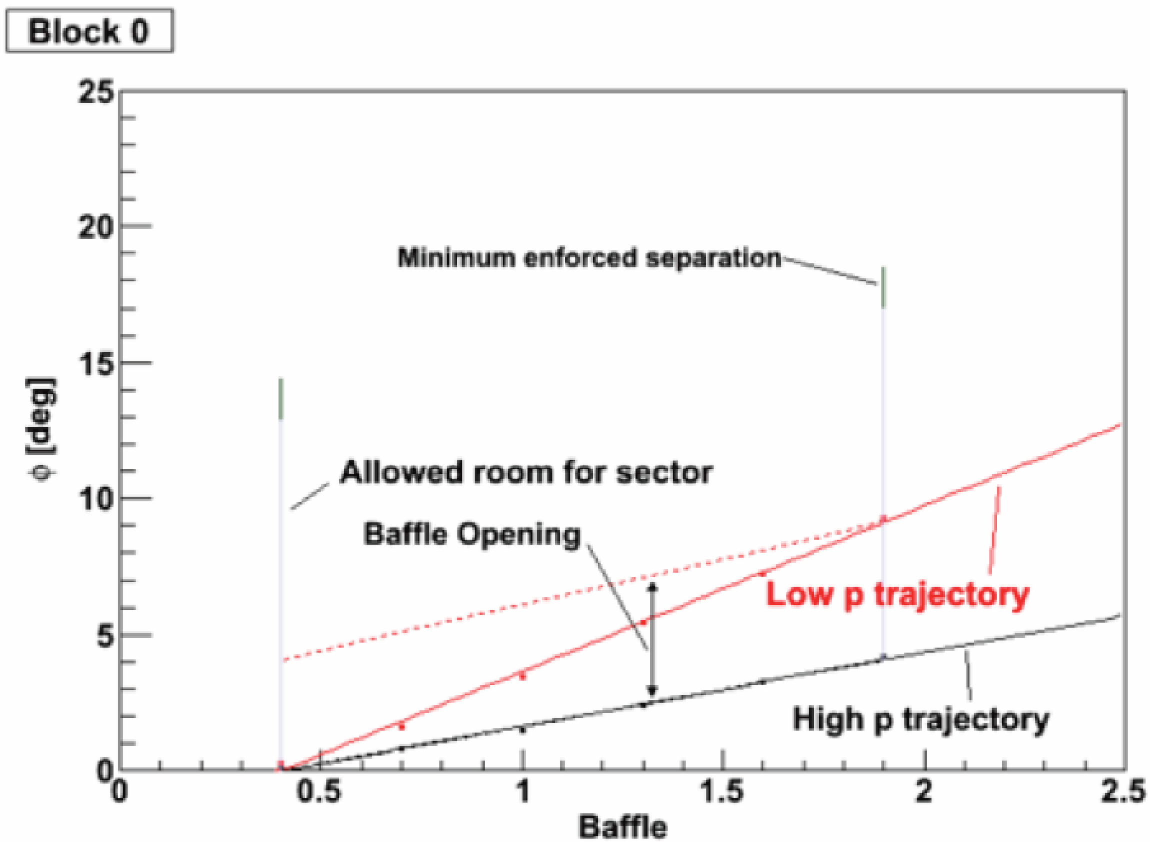


Figure 50: Raytraced electron trajectories used in baffle width design.

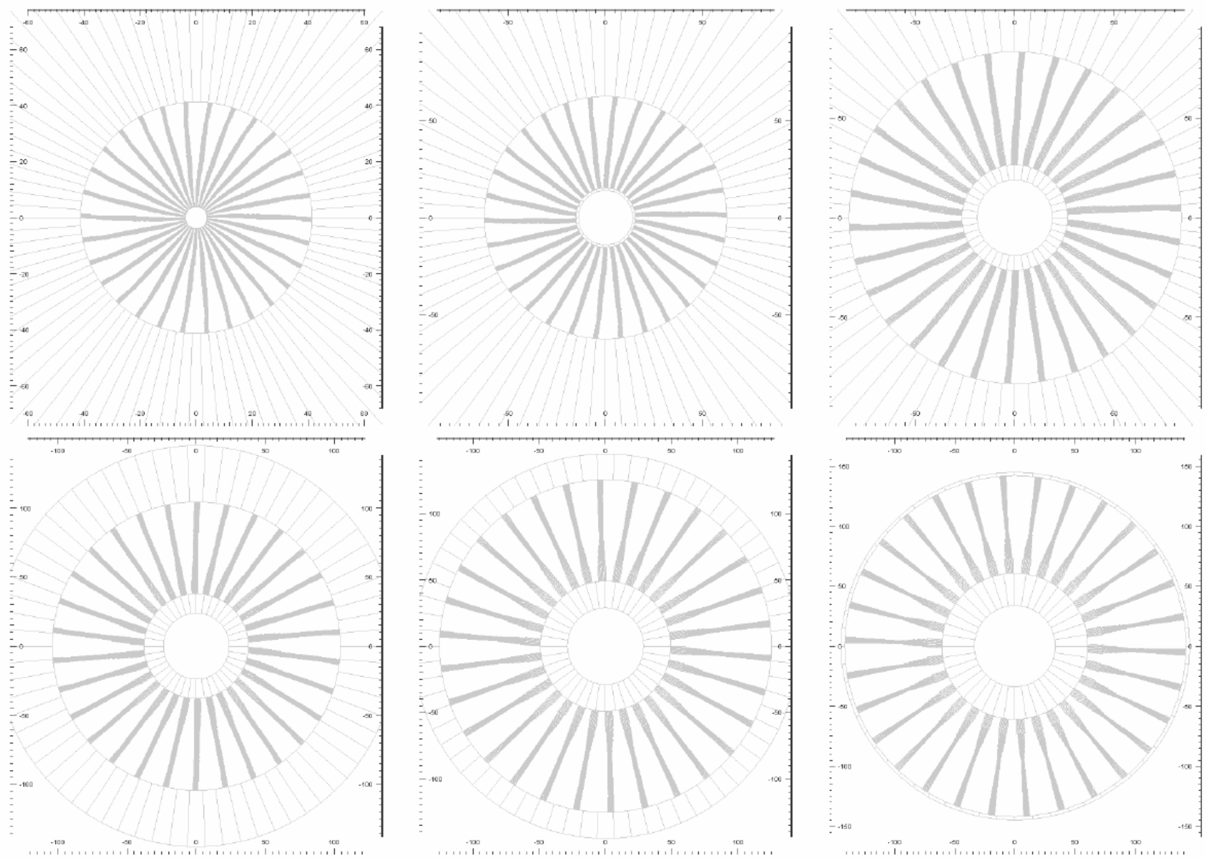


Figure 51: Baffle profiles

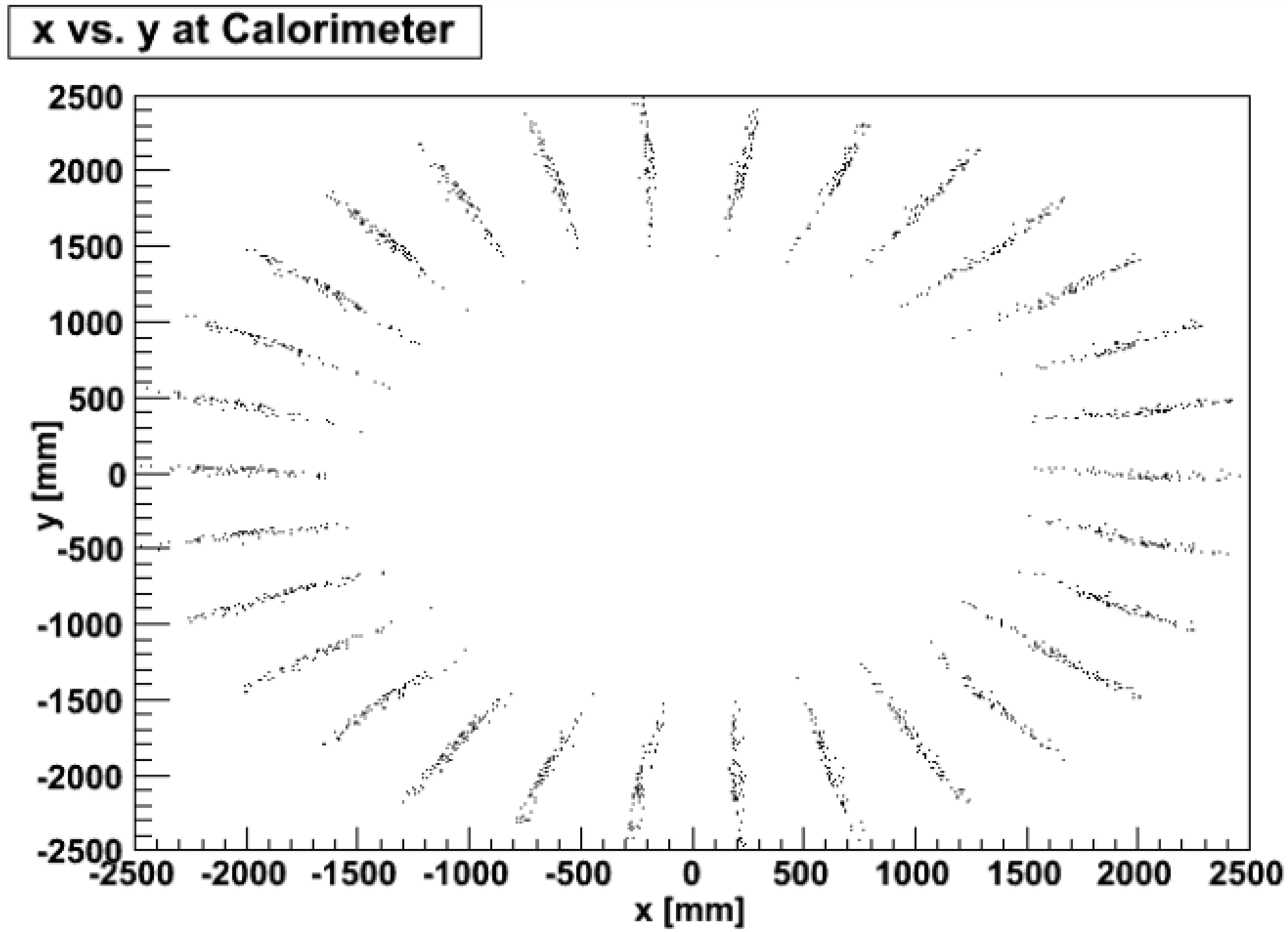
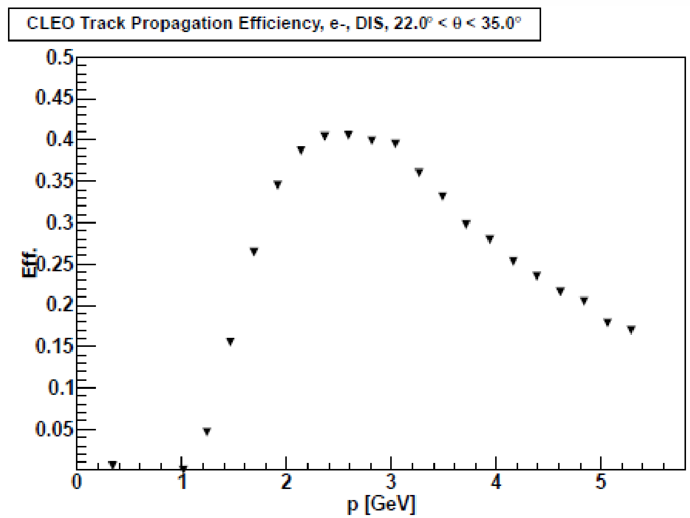


Figure 52: Photons leak through baffles



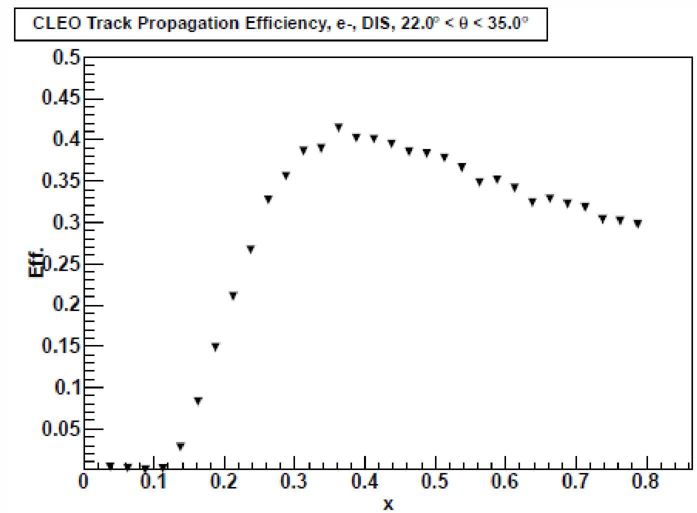


Figure 53: DIS electron propagation efficiencies