

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

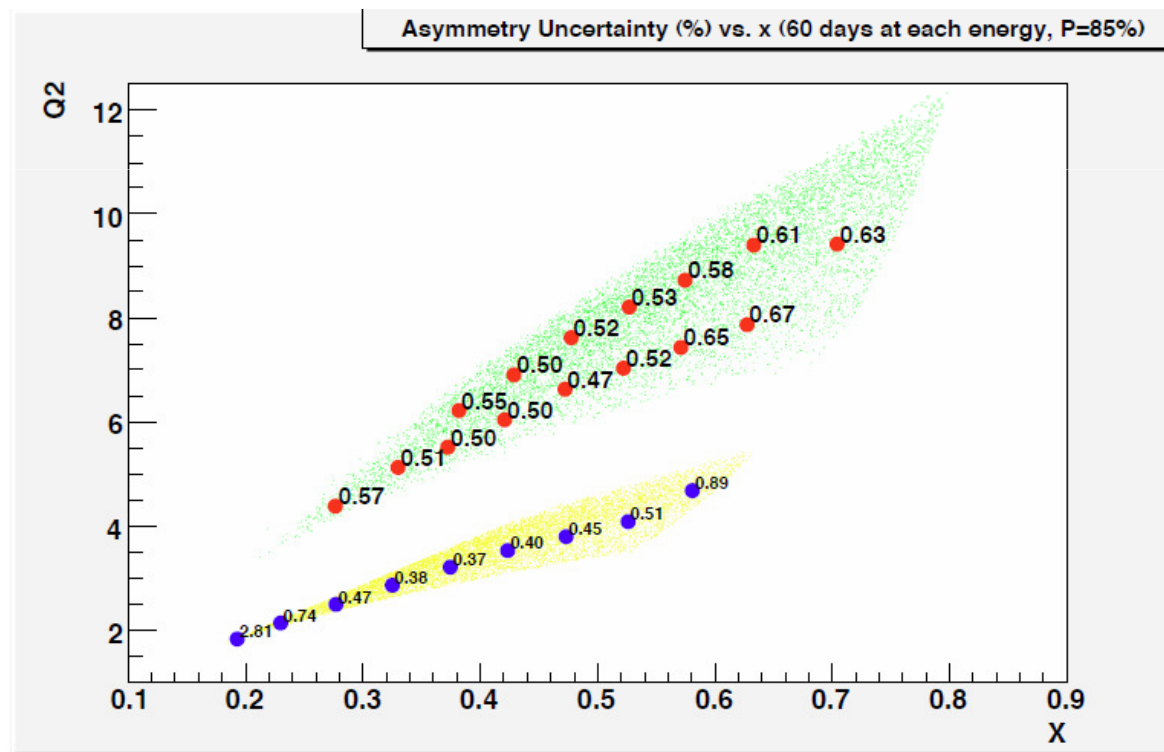


Figure 4: Anticipated statistical precision for Solid

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

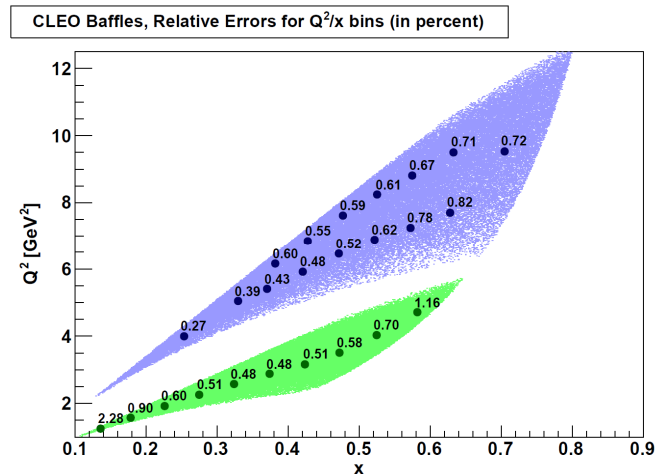
0.20,0.28,0.39,0.36,0.45,0.38,0.48,0.44,0.57,0.49,0.74,0.57,0.81,0.62,0.65

The binning should be same as Babar previous plot used

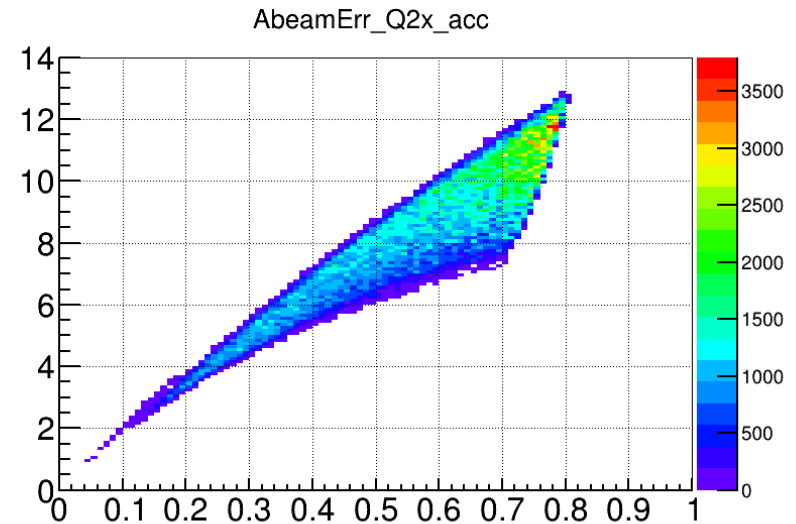
larger Z baffle
Zhiwen simulation

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

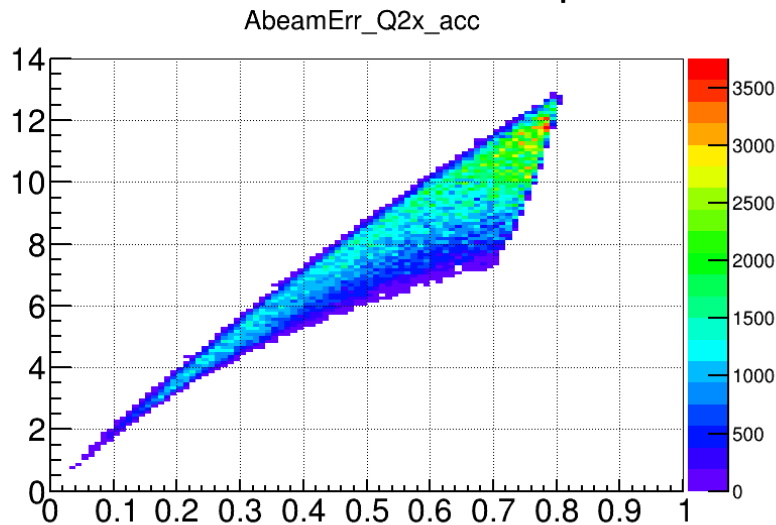
The binning should be same as Babar previous plot used

The result are similar

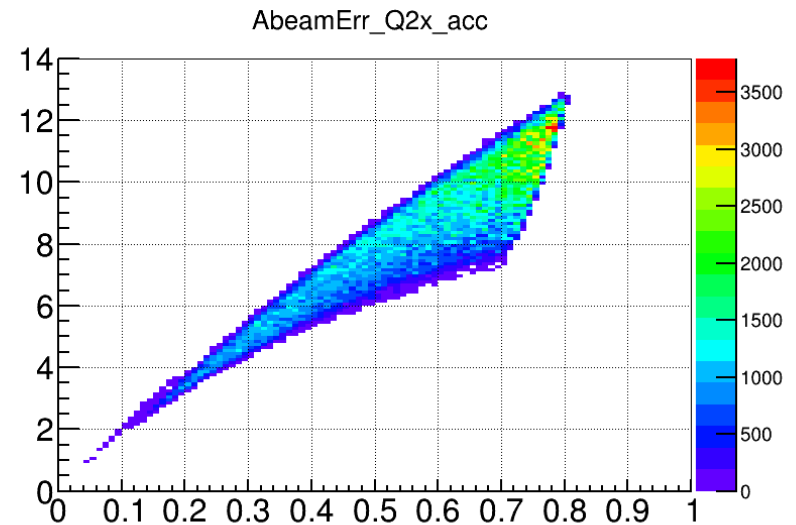
0.17,0.24,0.36,0.38,0.42,0.39,0.48,0.44,0.56,0.51,0.66,0.64,0.75,0.70,0.67

Smaller Z baffle
Zhiwen simulation
Optimized binning

This is from Smaller Z baffle with optimized binning



Smaller Z baffle
Zhiwen simulation



larger Z baffle
Zhiwen simulation

Compare general acceptance

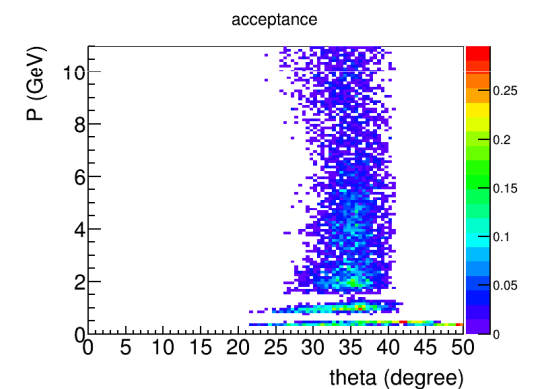
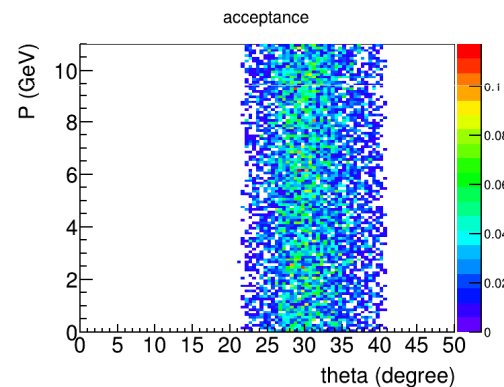
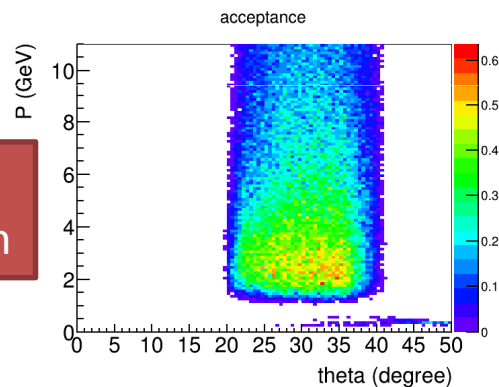
- Smaller Z baffle has more lowE negative acceptance
- Neutral acceptance are similar
- Smaller Z baffle has almost double positive lowE leak
- The impact on GEM and EC needs to be checked

negative

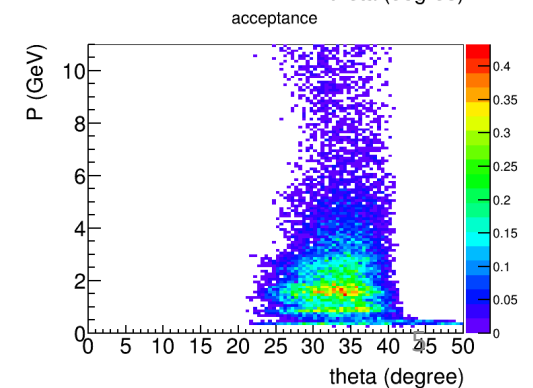
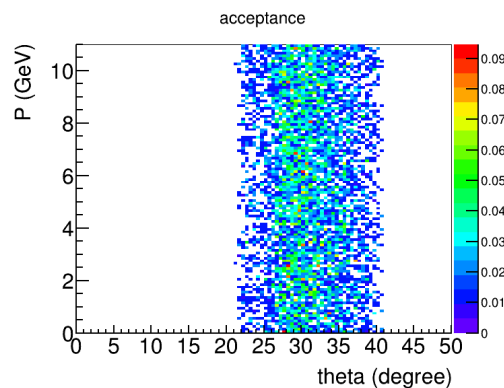
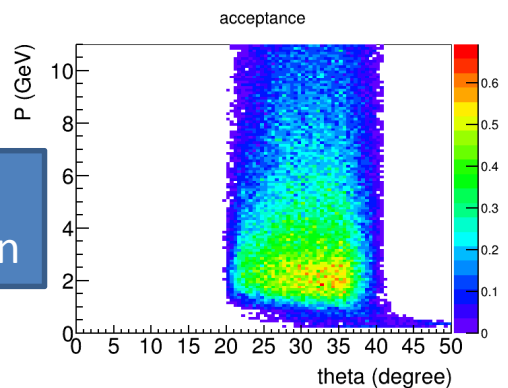
neutral

positive

larger Z baffle
Zhiwen simulation



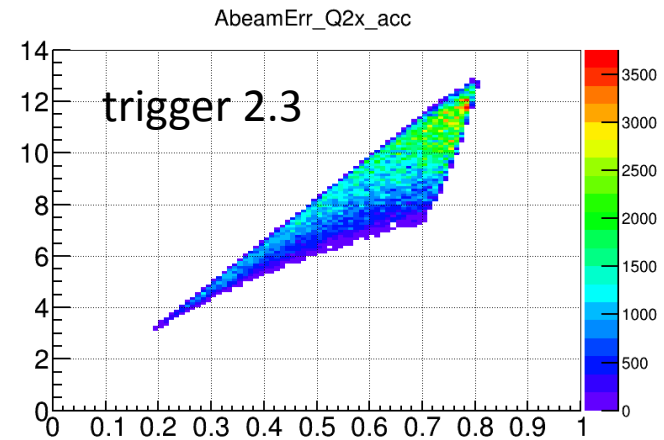
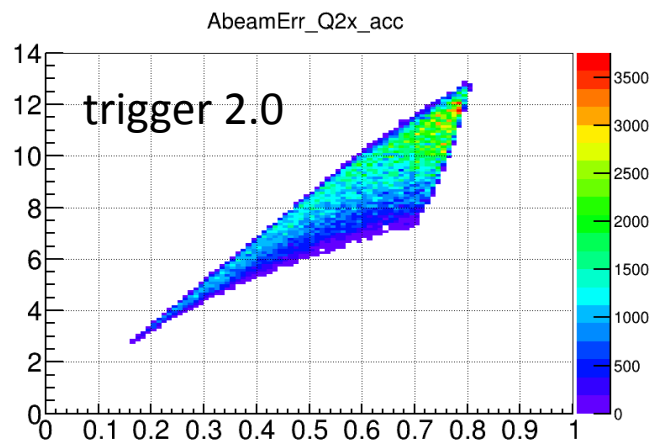
Smaller Z baffle
Zhiwen simulation



Trigger effect of smaller Z baffle

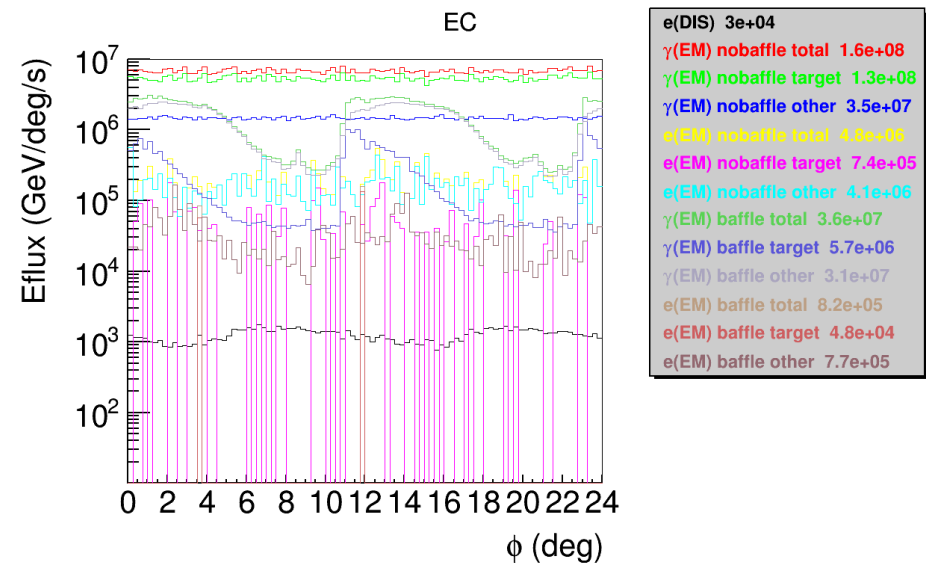
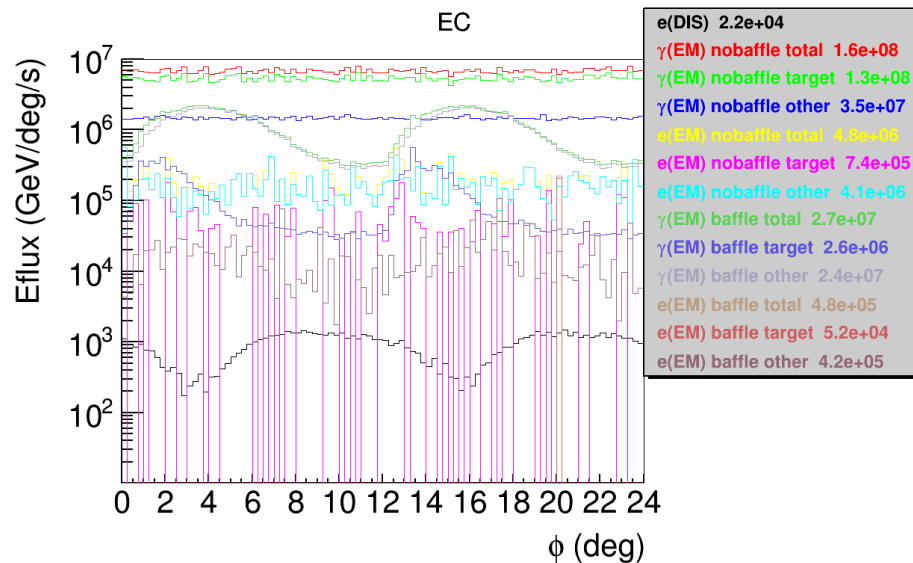
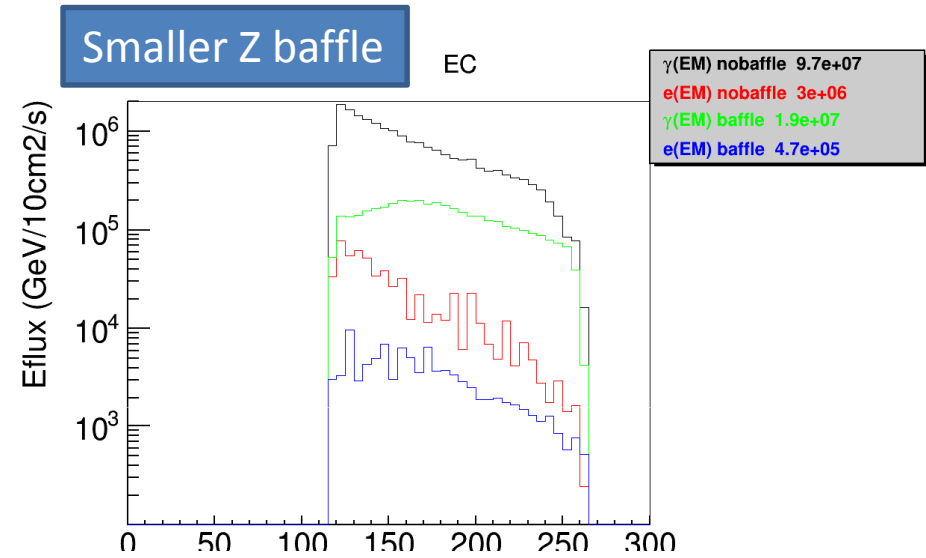
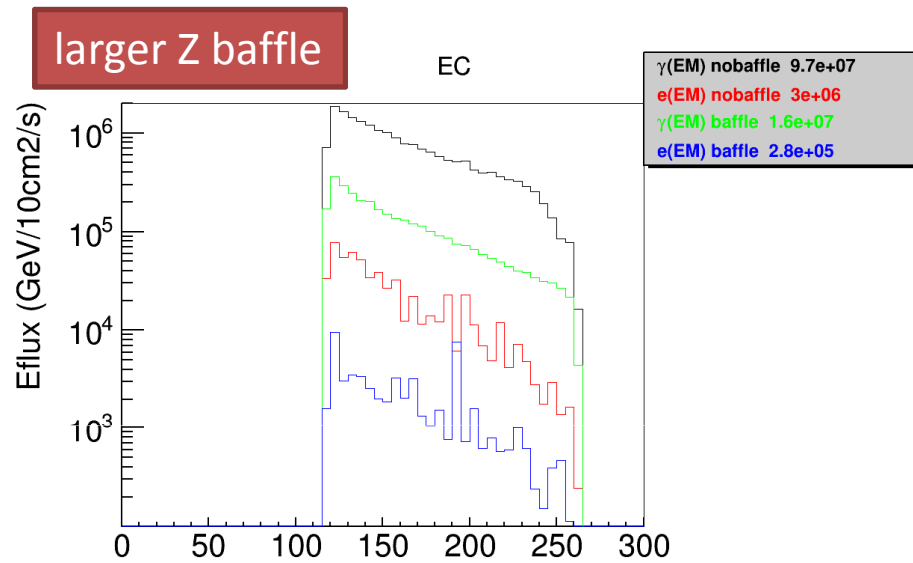
ApvErr	trigger (GeV)
0.17,0.24,0.36,0.38,0.42,0.39,0.48,0.44,0.56,0.51,0.66,0.64,0.75,0.70,0.67	0.0
0.20,0.26,0.36,0.40,0.42,0.40,0.48,0.44,0.56,0.51,0.66,0.64,0.75,0.70,0.67	1.5
0.27,0.31,0.37,0.62,0.45,0.51,0.48,0.51,0.56,0.54,0.66,0.65,0.75,0.70,0.67	2.0
0.38,0.37,0.39,0.96,0.42,0.74,0.48,0.65,0.56,0.65,0.66,0.75,0.75,0.74,0.67	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

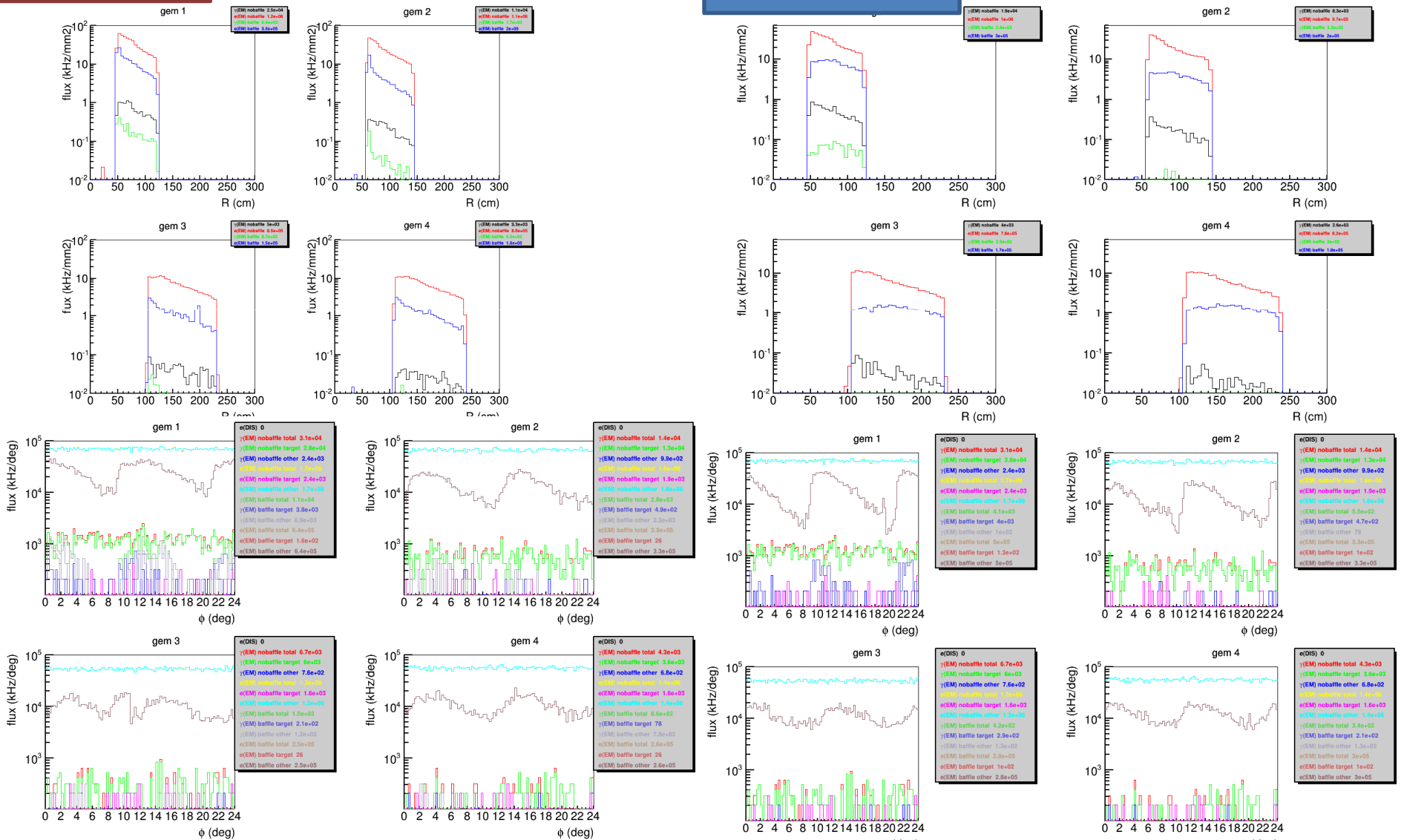


EM Background on GEM

- 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

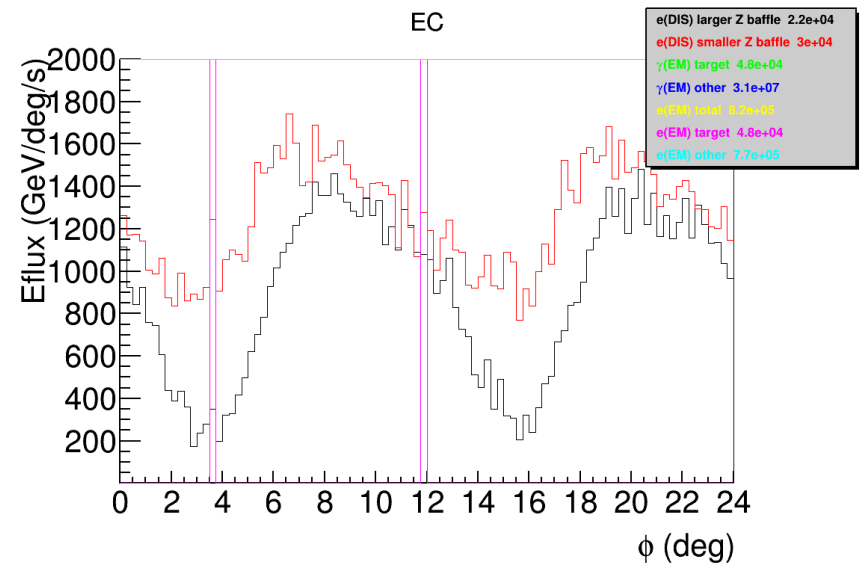
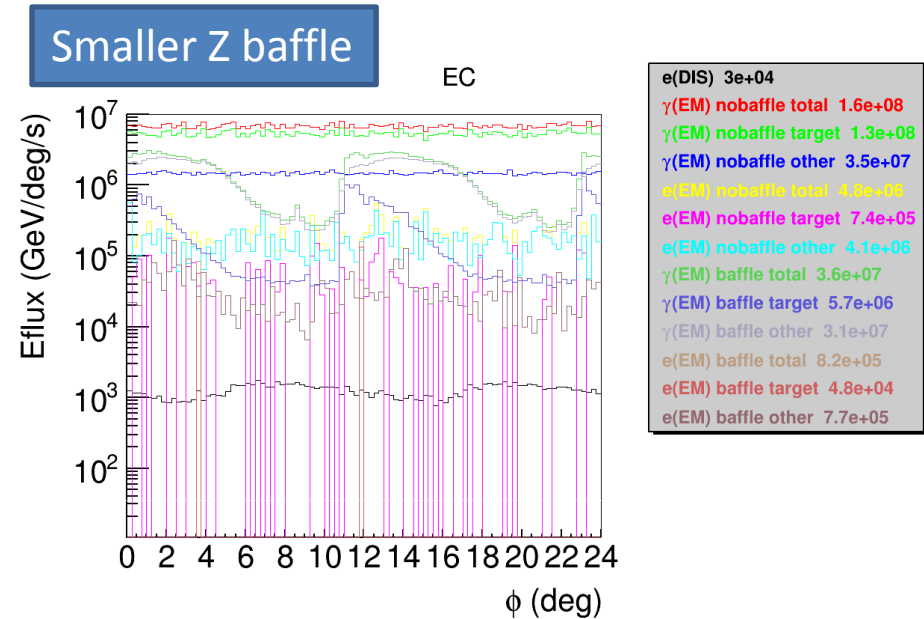


eDIS pattern in Phi on EC

eDIS on EC has different pattern 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)
 - 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)
 - http://hallaweb.jlab.org/12GeV/SoLID/download/baffle/baffle_largerZ_extrablock

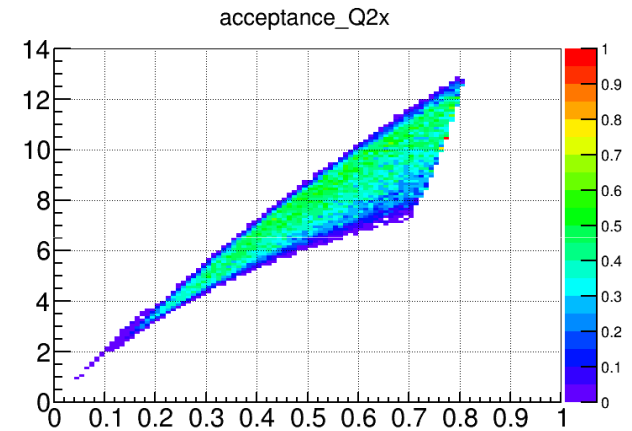
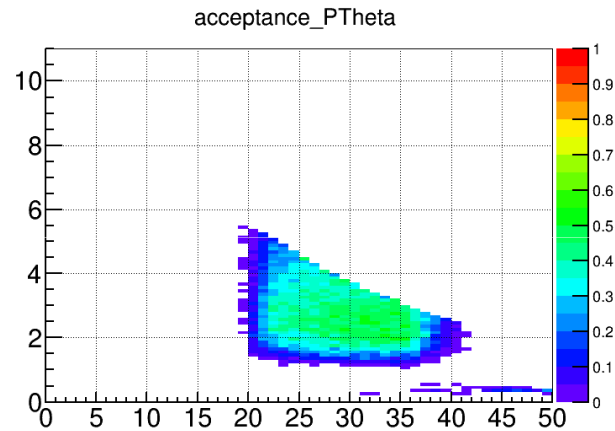
Remaining questions

- 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?

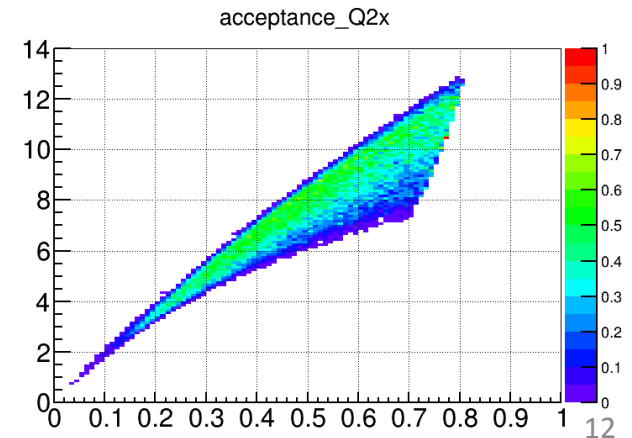
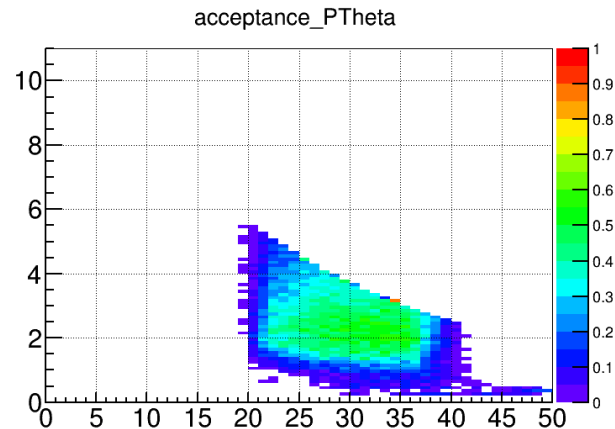
Compare eDIS acceptance

- 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 $0.63e39/cm^2/s$ from eicRate, then apply $W < 2\text{GeV}$ cut
- Use GEMC 1.7 and CLEOv8 field map
- $ApvErr =$
 $1/\sqrt{\text{Sum}(\text{rate} * \text{acc} * \text{time})} / Apv_acc_ave / Pb * 100$
 - Average of Apv of accepted events in a bin,
 $Apv_acc_ave = \text{Sum}(Abeam * \text{rate} * \text{acc}) / \text{Sum}(\text{rate} * \text{acc})$
 - beam polarization, $Pb = 0.85$
 - 120 days running, $\text{time} = 120 * 24 * 3600$
- No event by event fitting for Apv (Does this matter much?)

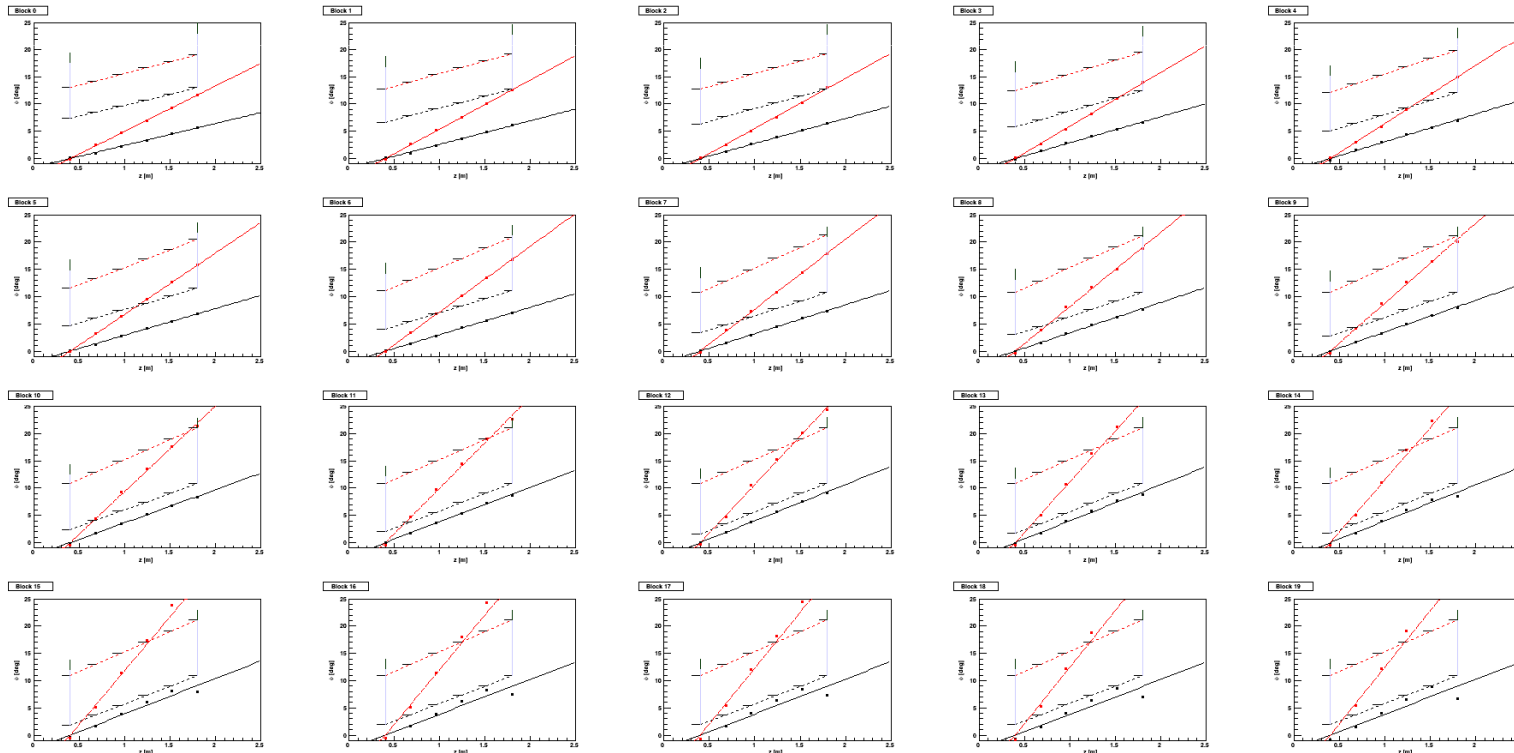
Design Detail

- 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

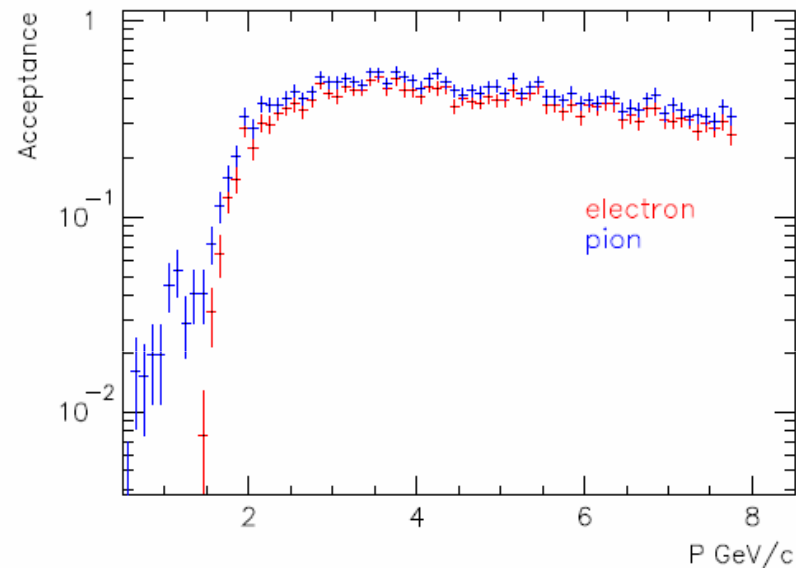


Figure 3.8: The acceptance dependence on the particle momentum for electrons and pions. The baffles reject electrons with $p < 1.5$ GeV, while pions below 1.5 GeV are reduced by a factor of 20-50.

- 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(?)

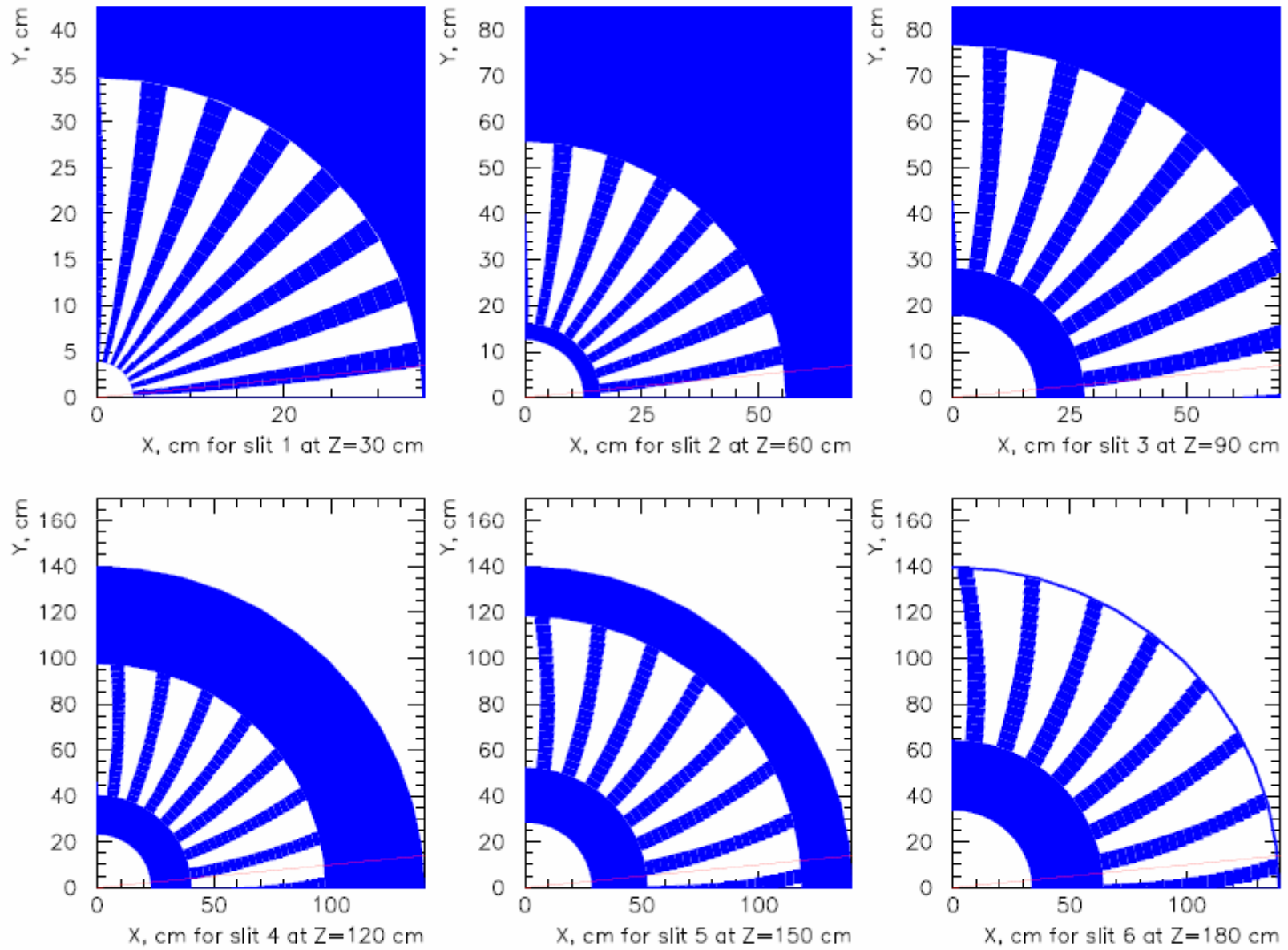


Figure 3.7: The optimized geometry of the baffles.

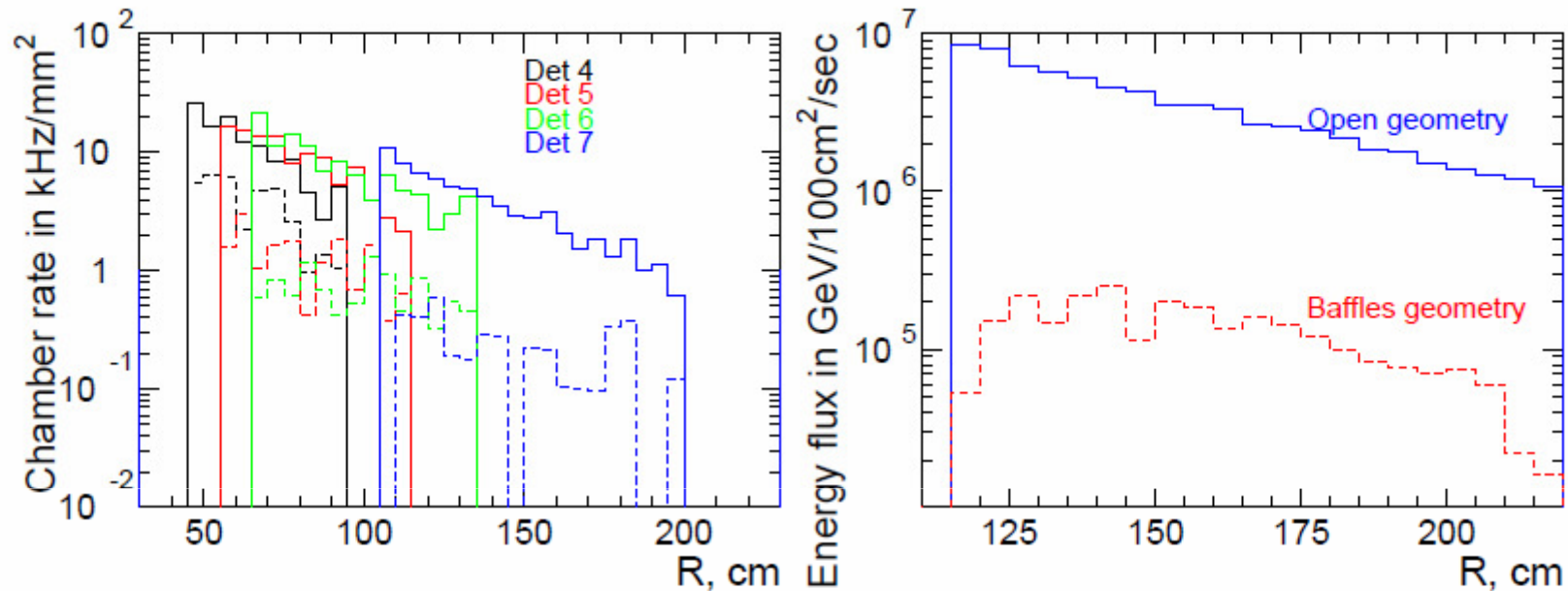


Figure 3.9: Left: the background rate in the coordinate detectors in kHz per mm², depending on the radius, without the baffles (the solid lines) and with the baffles (dashed lines). The baffles reduce the rate by a factor of ~ 10 for the detectors 5-8. Right: the energy flow in the EM calorimeter in GeV/100cm²/s, without baffles and with them. The baffles reduce the rate by a factor of 15-50.

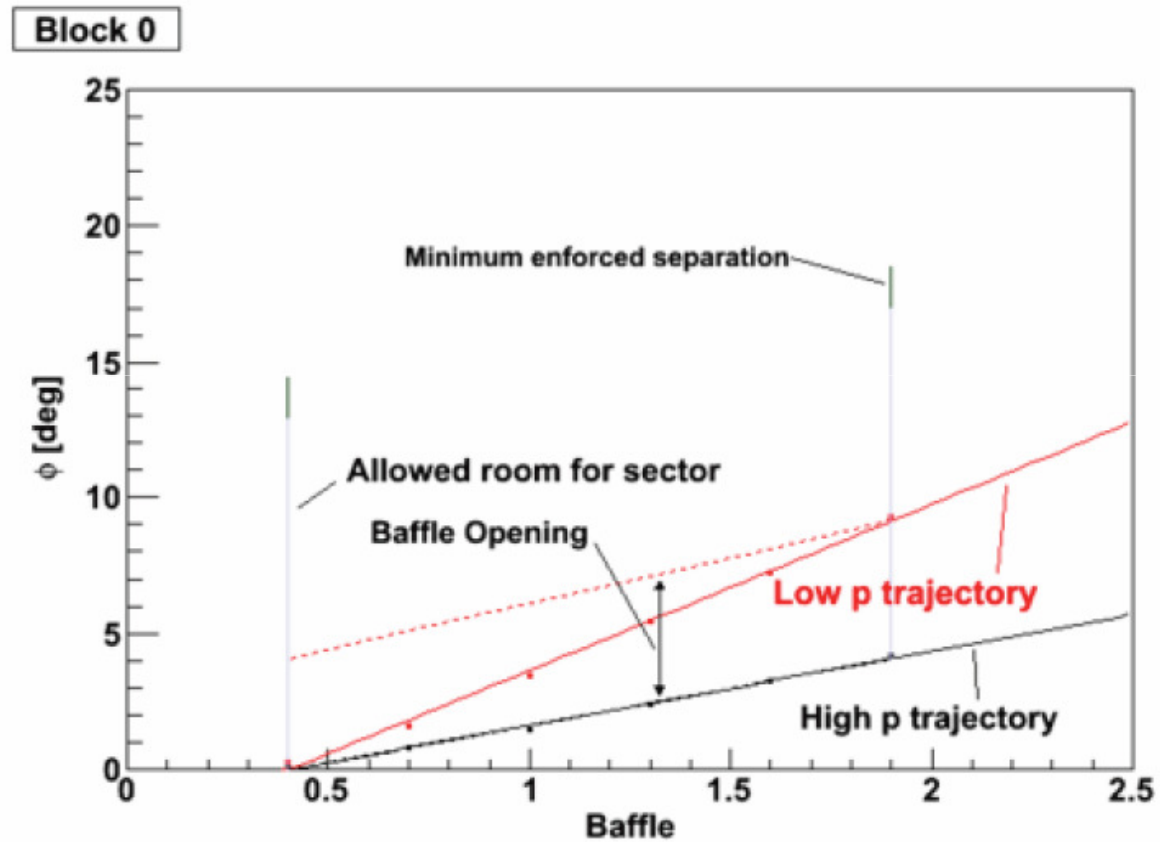


Figure 50: Raytraced electron trajectories used in baffle width design.

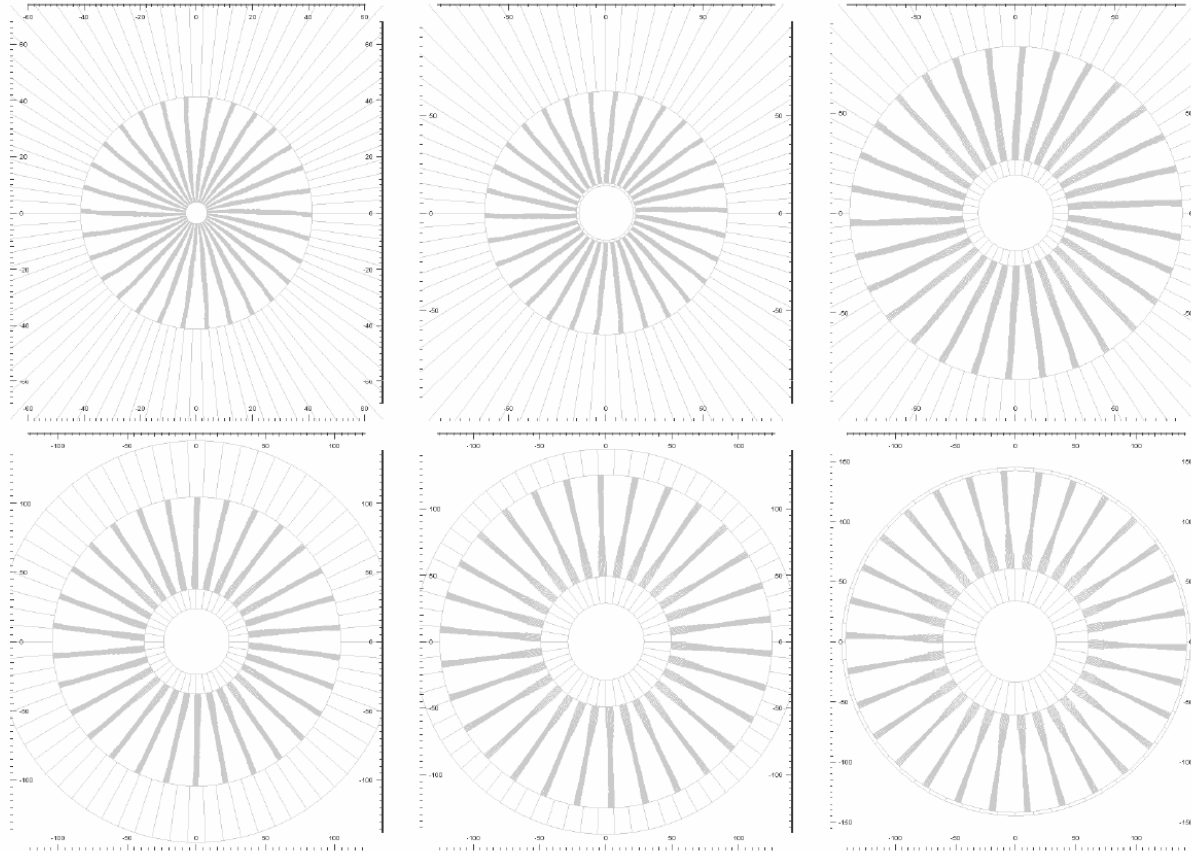


Figure 51: Baffle profiles

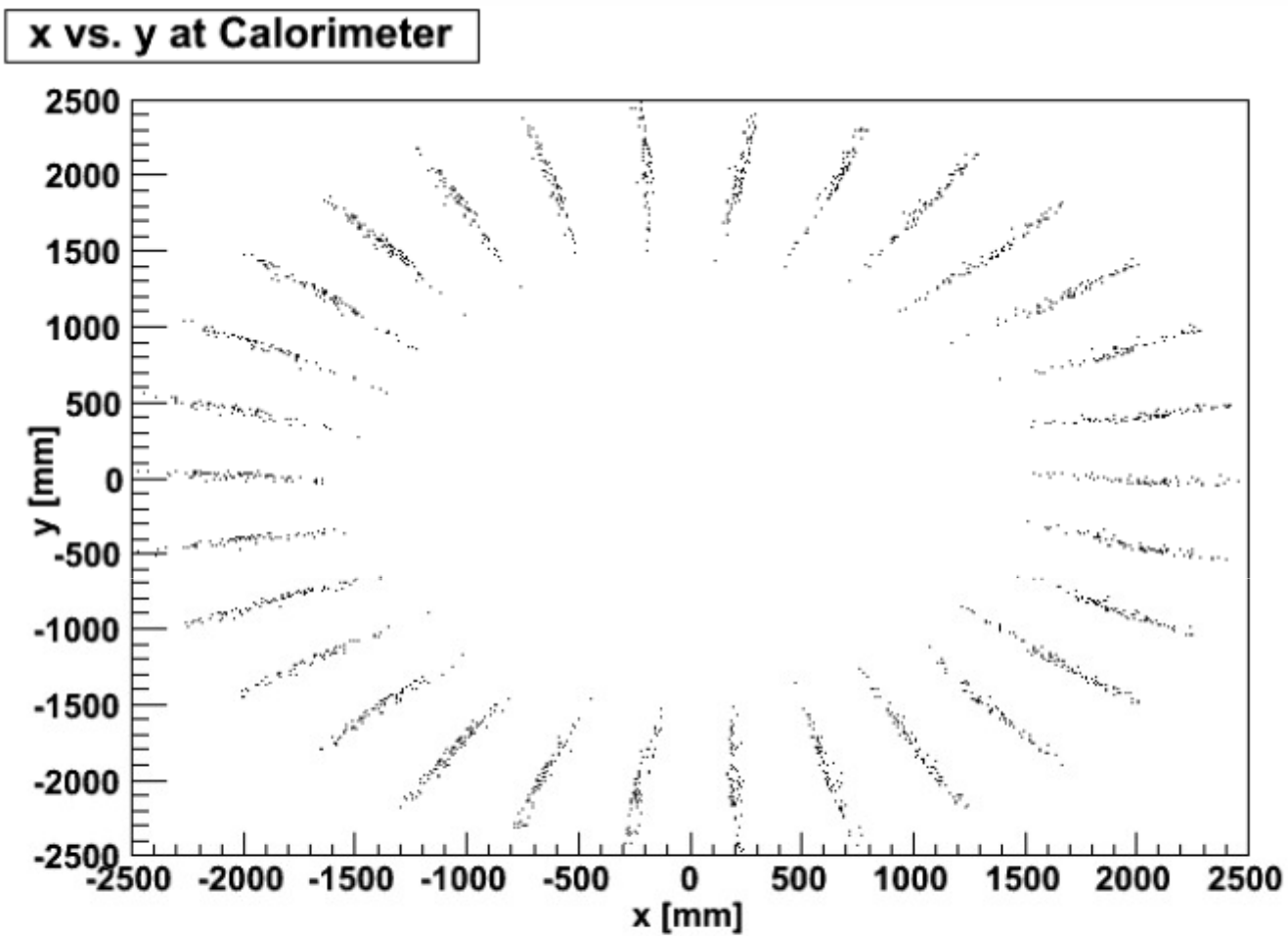


Figure 52: Photons leak through baffles

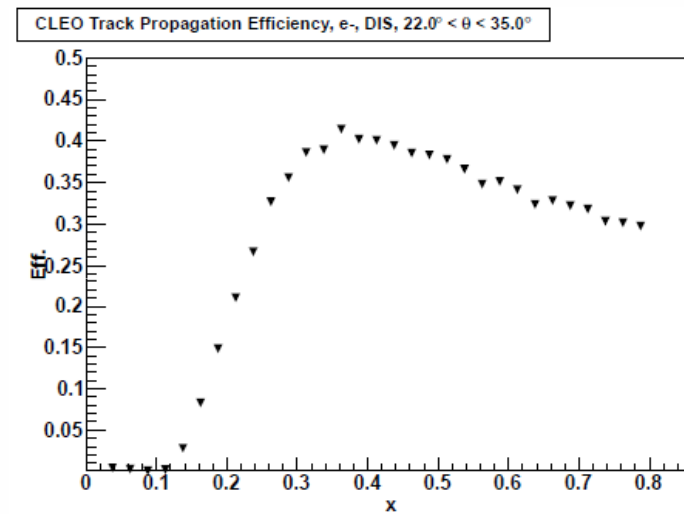
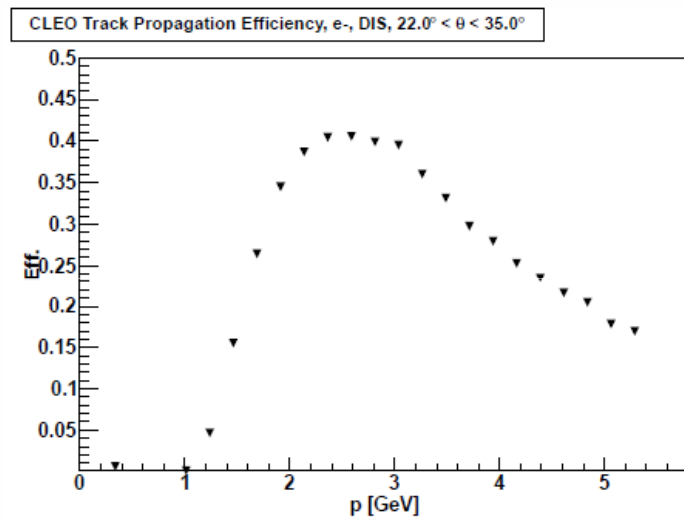


Figure 53: DIS electron propagation efficiencies