SoLID baffle update

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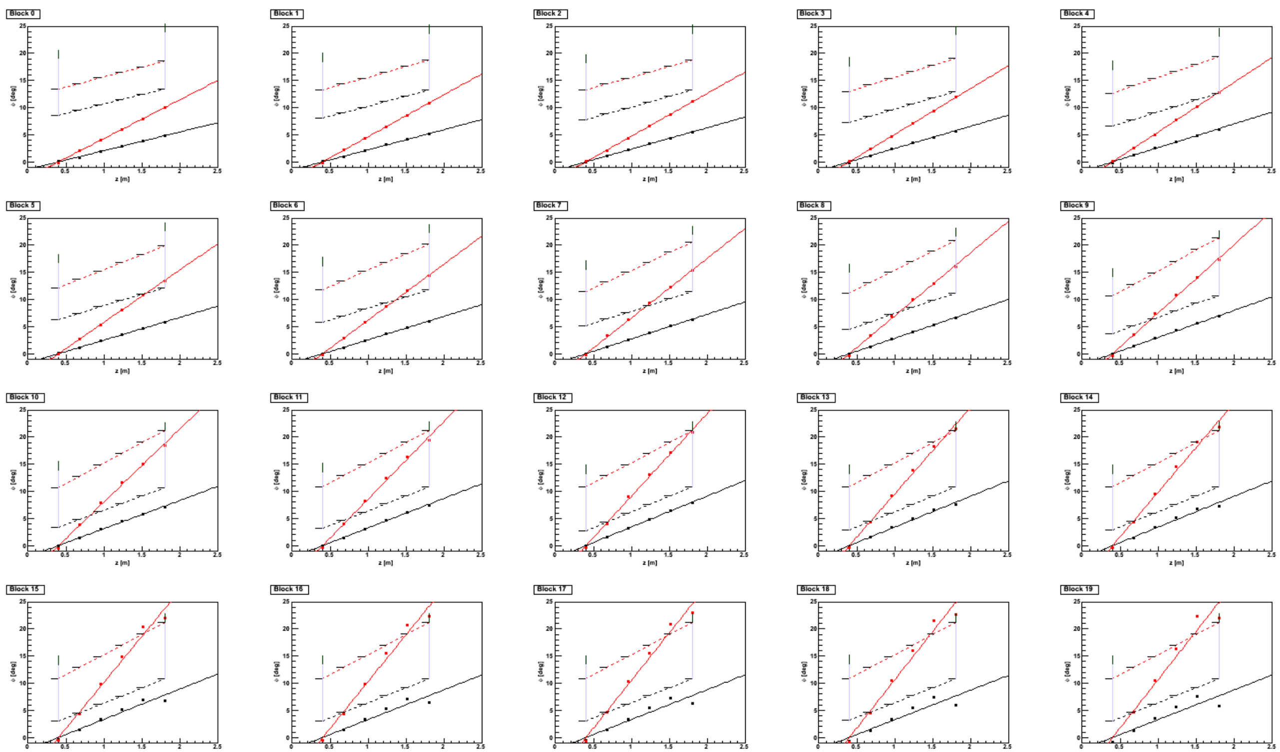
Design constraint

- Still use SoLID CLEOv8 field map
- Still 30 sectors with each sector covering 12 deg
- Still each plate is 9cm thick of lead
- Fit within the current setup without overlap
  - Z (40, 68, 96, 124, 152, 180) cm
- Opening in R is optimized for acceptance from 21 to 36 deg for full 40cm long target with center at 10cm like Like GEM and EC
  - Rin (2.11, 12.86, 23.61, 34.36, 45.10, 55.85)cm
    - Determined by Z of the front plane of baffle plates
  - Rout (39.60, 59.94, 80.28, 100.63, 120.97, 141.31)cm
    - Determined by Z of the back plane of baffle plates

Design approach

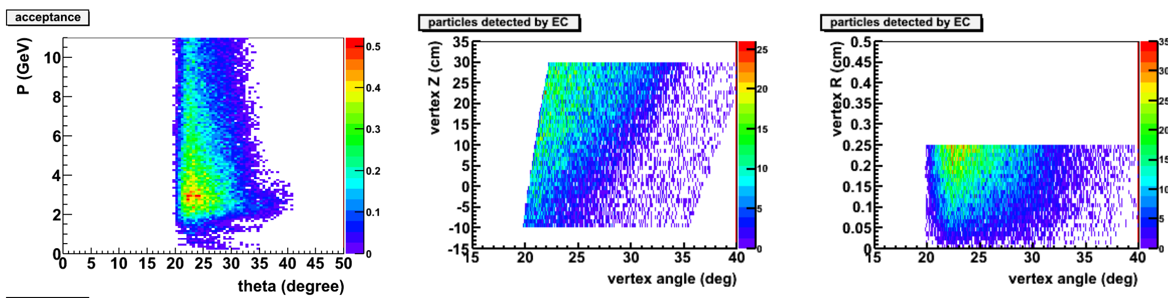
- Continue with Seamus's approach
  - In simulation, throw negative particles from target position with field, record tracks at different position
  - Then do linear fitting to figure out what kind of blocking should be at the assumed baffle plates position.
  - refer to
    - https://hallaweb.jlab.org/wiki/index.php/Baffle_Design
    - https://hallaweb.jlab.org/wiki/index.php/Solid_design_FOM
- Fixed a few bugs in the baffle code



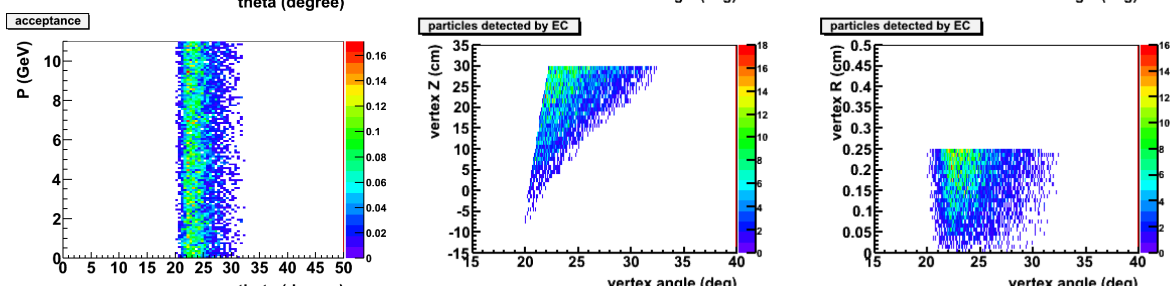
First look

- Take baffle parameters directly from the output of the baffle code with scale factor = 1 (meaning no scaling)
- Use kinematic evenly distribution particles from full target and 7mmD round (similar to 5mmx5mm square) raster to see acceptance at EC
- What we see
  - Negative acceptance is ok, but a lot neutral and positive leaks
  - much more particles from downstream target target go through than from upstream half target for both any type of particles
  - Particles from off beamline appearing as more hits on EC than close to axis have geometric effect

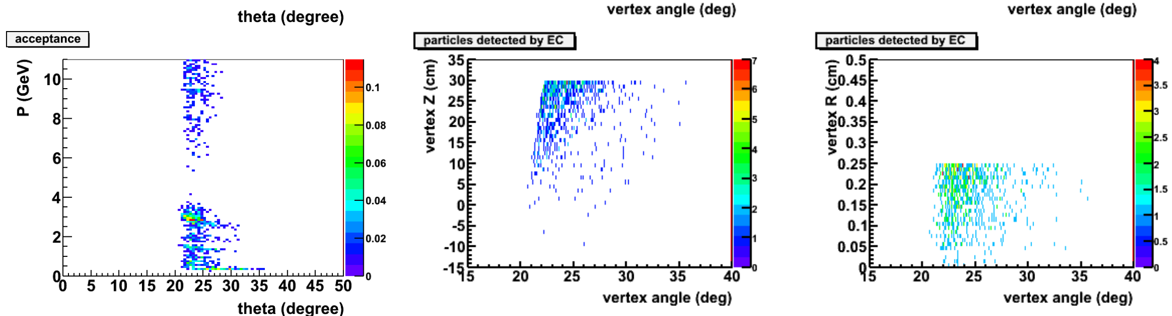
negative



neutral

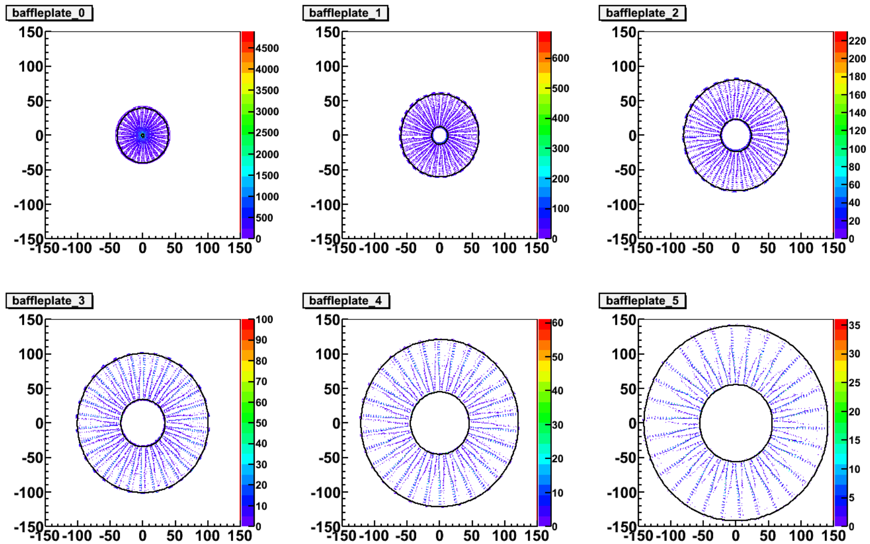


neutral



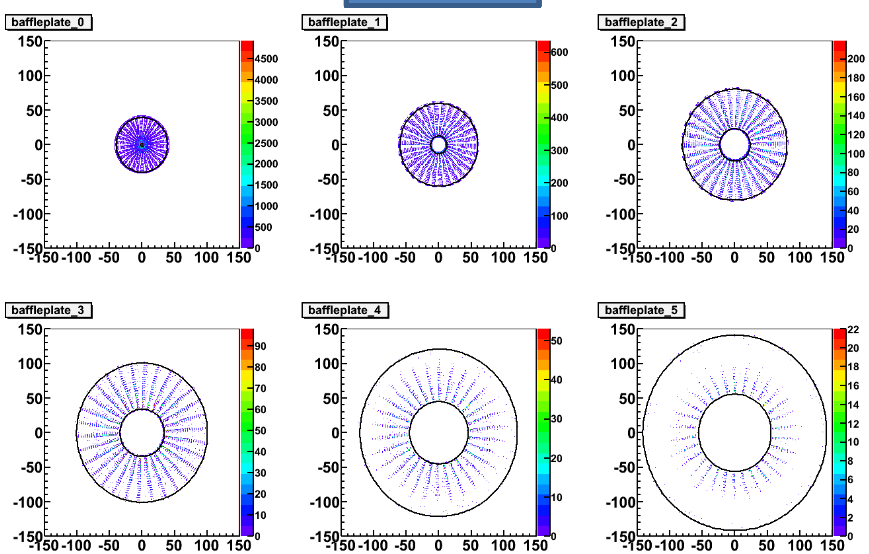
How to tweak it

negative

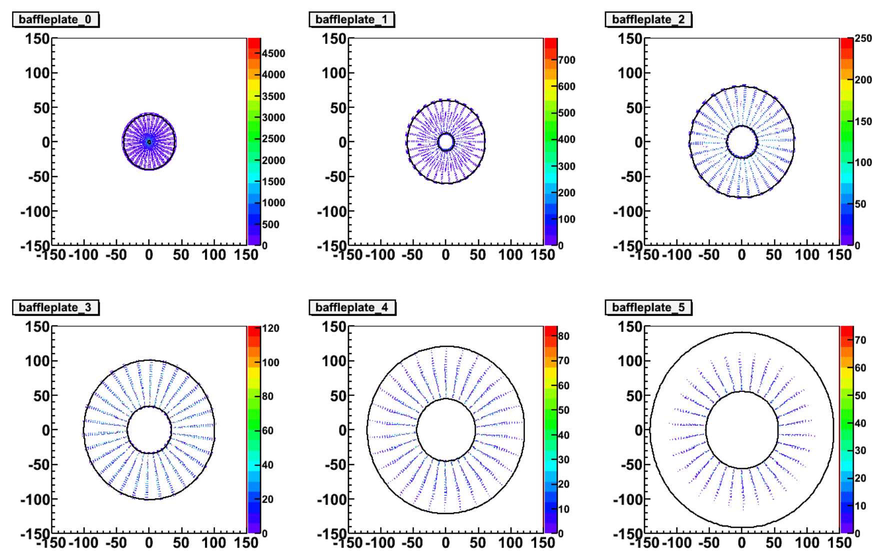


- Enlarge the scale factor. This will block all particles
- Increase the inner blocks of the last baffle on their phi angle coverage to block more neutral and positive and block less negative.
    - Due to the observation of that neutral and positive hit on last baffle are mostly at the inner blocks while negative has full radius range
- Combine these two to block almost all neutral and positive, then use POVDIS physics to pick what is best for negative
    - Note: blocking photon always sacrifice high momentum electron (large Q2 and x)

positive



neutral



Tweak result

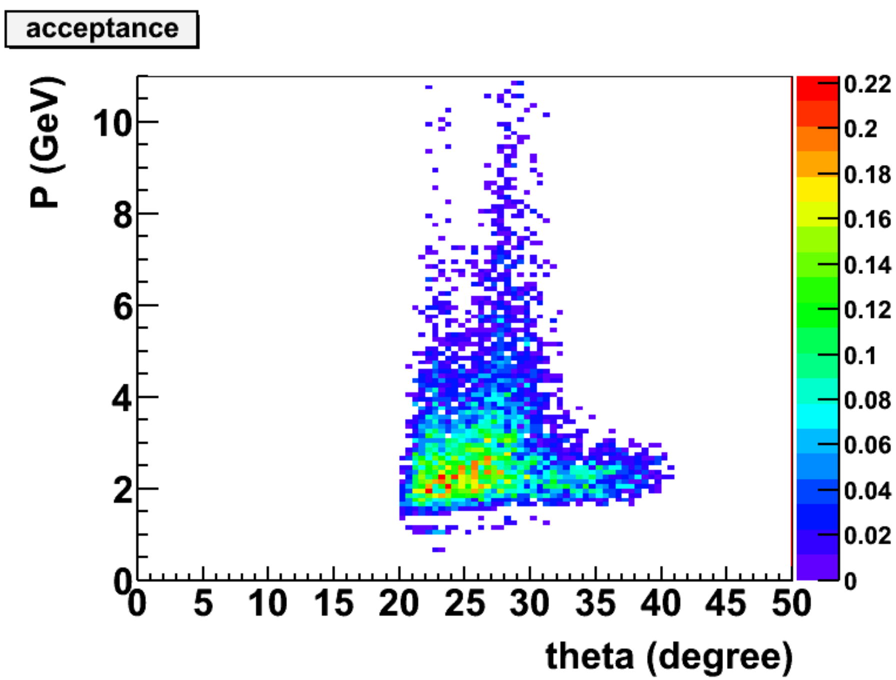
- All settings can block neutral and positive
  - Scale 1.2, additional angle 3 deg for R<77cm
  - Scale 1.3, additional angle 2 deg for R<77cm
  - Scale 1.4, additional angle 1 deg for R<77cm

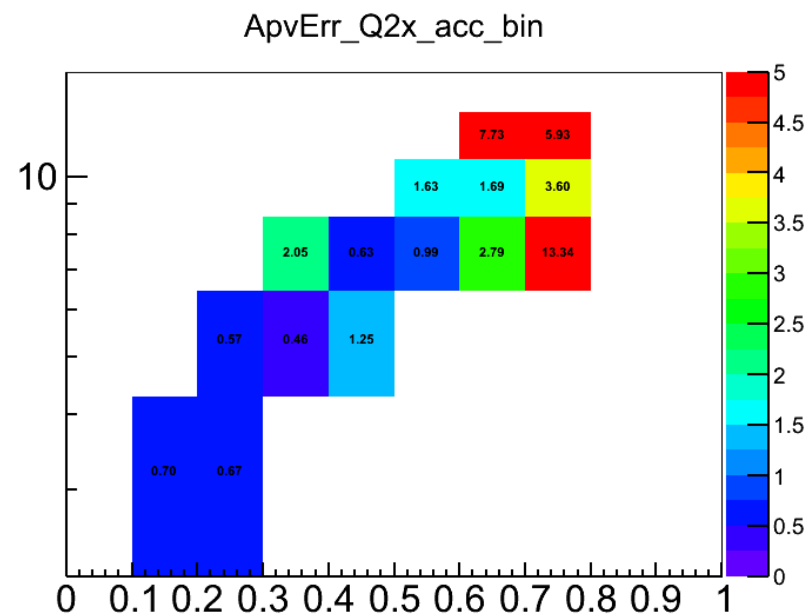
- The setting with "Scale 1.2, additional angle 3 deg for R<77cm" has best A_{pv} Error and thus chosen as current baffle

Acceptance and PVDIS A_{pv} Error

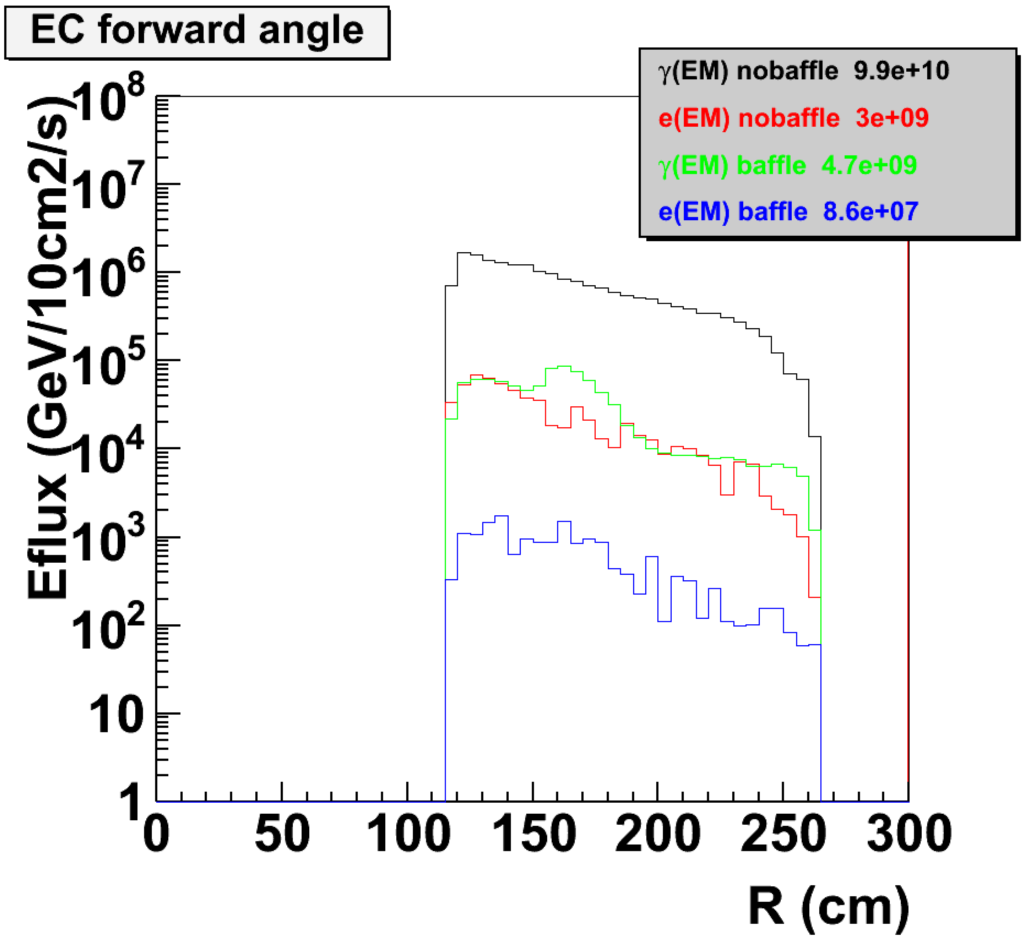
- The setting with “scale 1.2, additional angle 3”
- DIS electron on 40cm LD2 target with Lumi 1.27e39/cm2/s
- A_{pv} Error= 1/sqrt(acc*rate*time)/A_{pv}/Pbeam*100

  with $A_{pv} = 0.84e^{-4}$*Q2, Pbeam = 0.85, Time = 120 days in s
- See backup for more plots and comparison



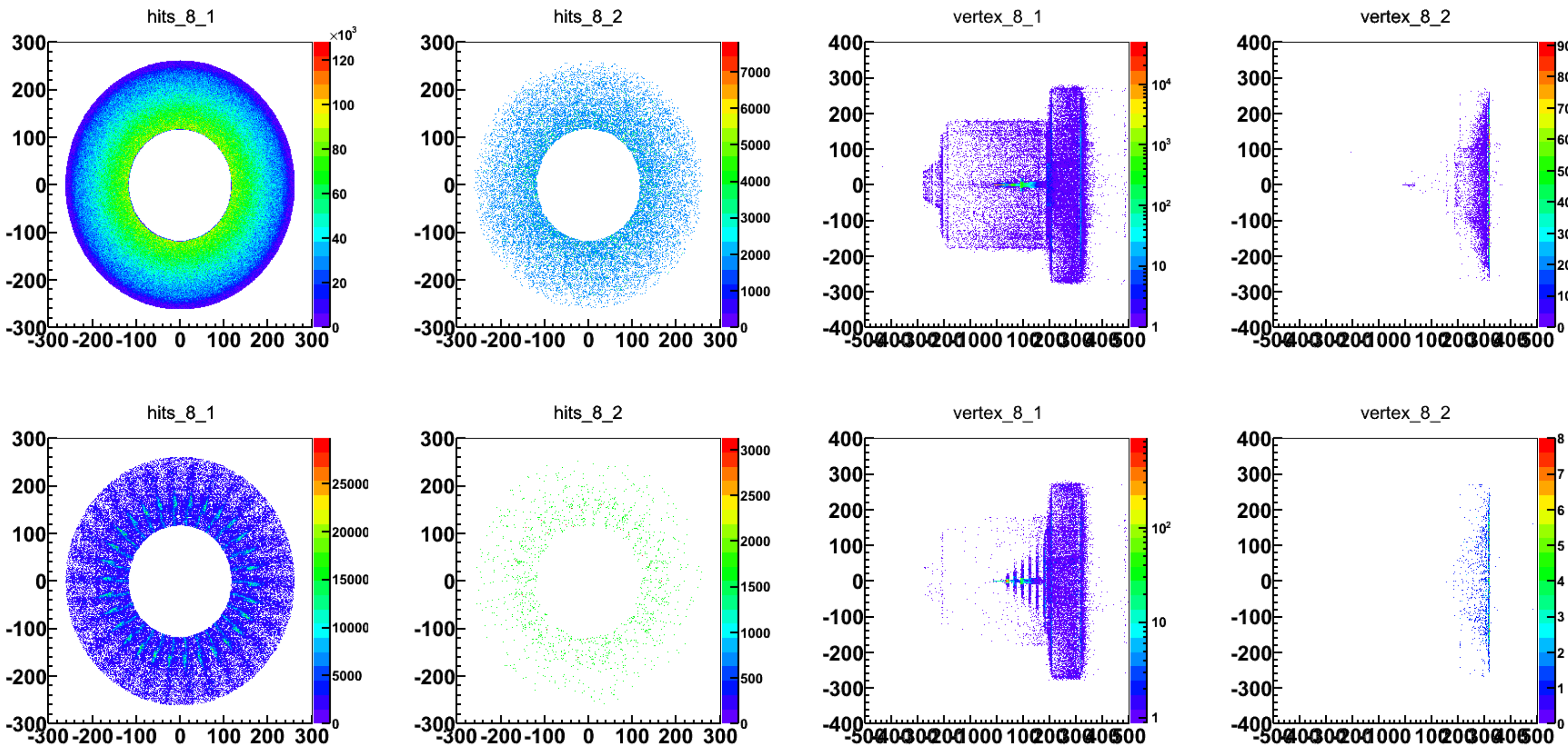


Eflux on EC

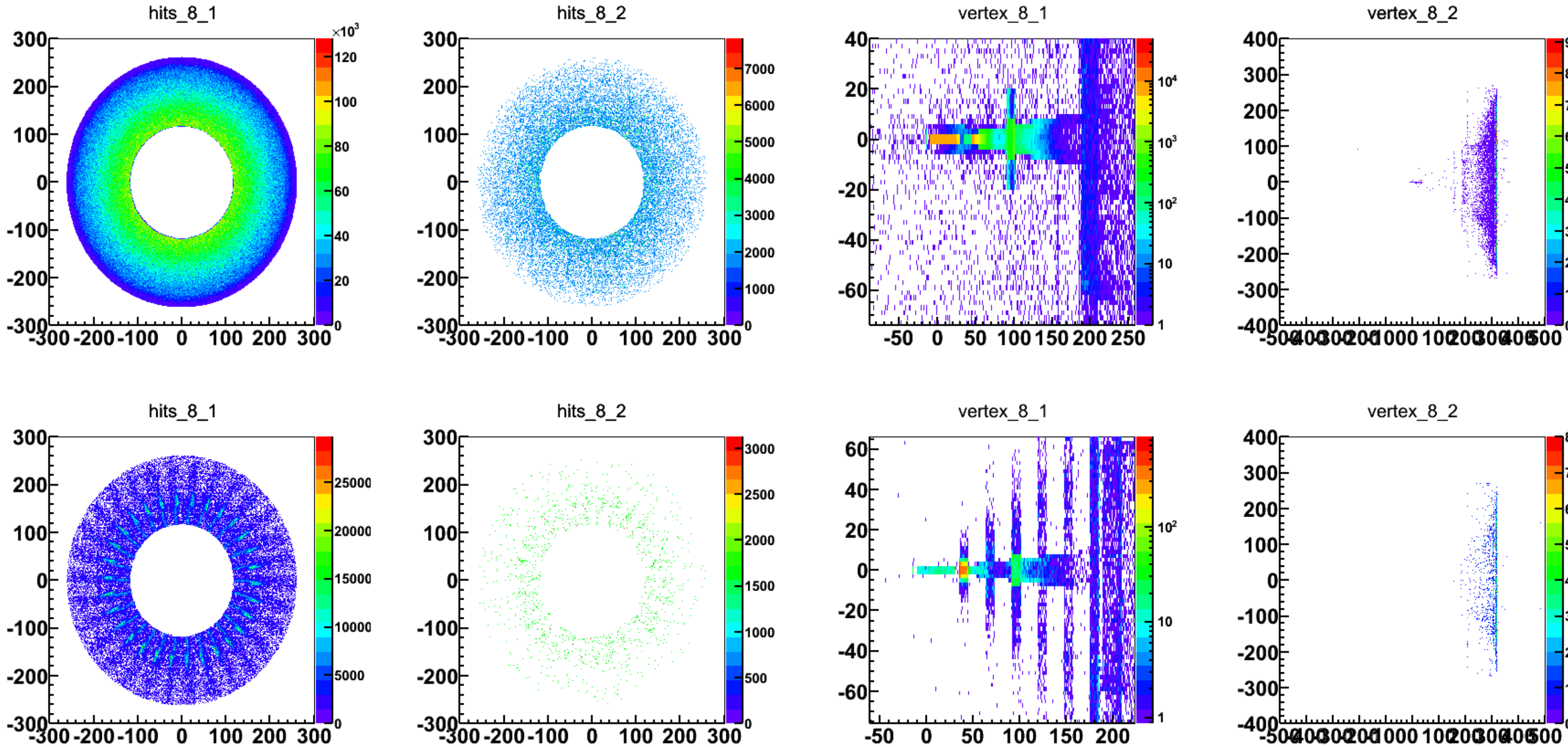


EC forward angle
γ(EM) nobaffle 9.9e+10
e(EM) nobaffle 3e+09
γ(EM) baffle 4.7e+09
e(EM) baffle 8.6e+07
Eflux (GeV/10cm2/s)
1
10
10^2
10^3
10^4
10^5
10^6
10^7
10^8
0
50
100
150
200
250
300
R (cm)

Background hits on EC



Background on EC



backup

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

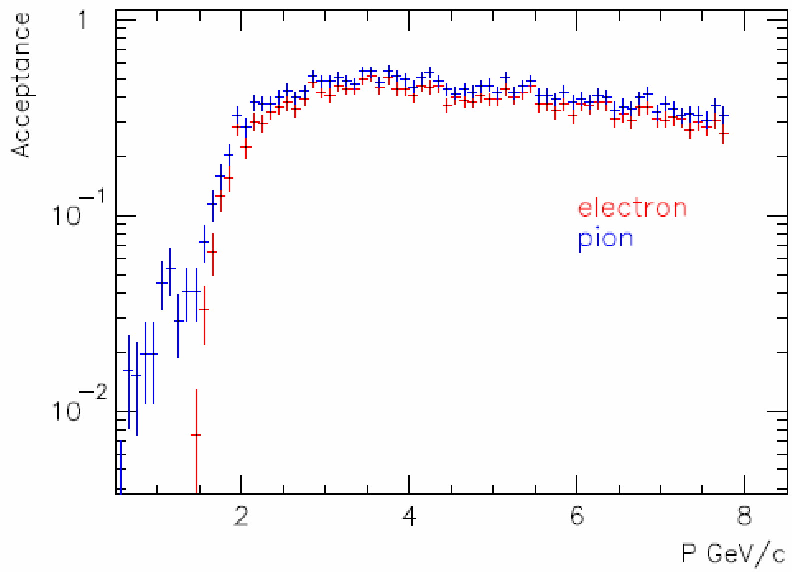


Figure 3.8: The acceptance dependence on the particle momentum for electrons and pions. The baffles reject electrons with $p < 1.5$ GeV, while pions below 1.5 GeV are reduced by a factor of 20-50.

- 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(?)

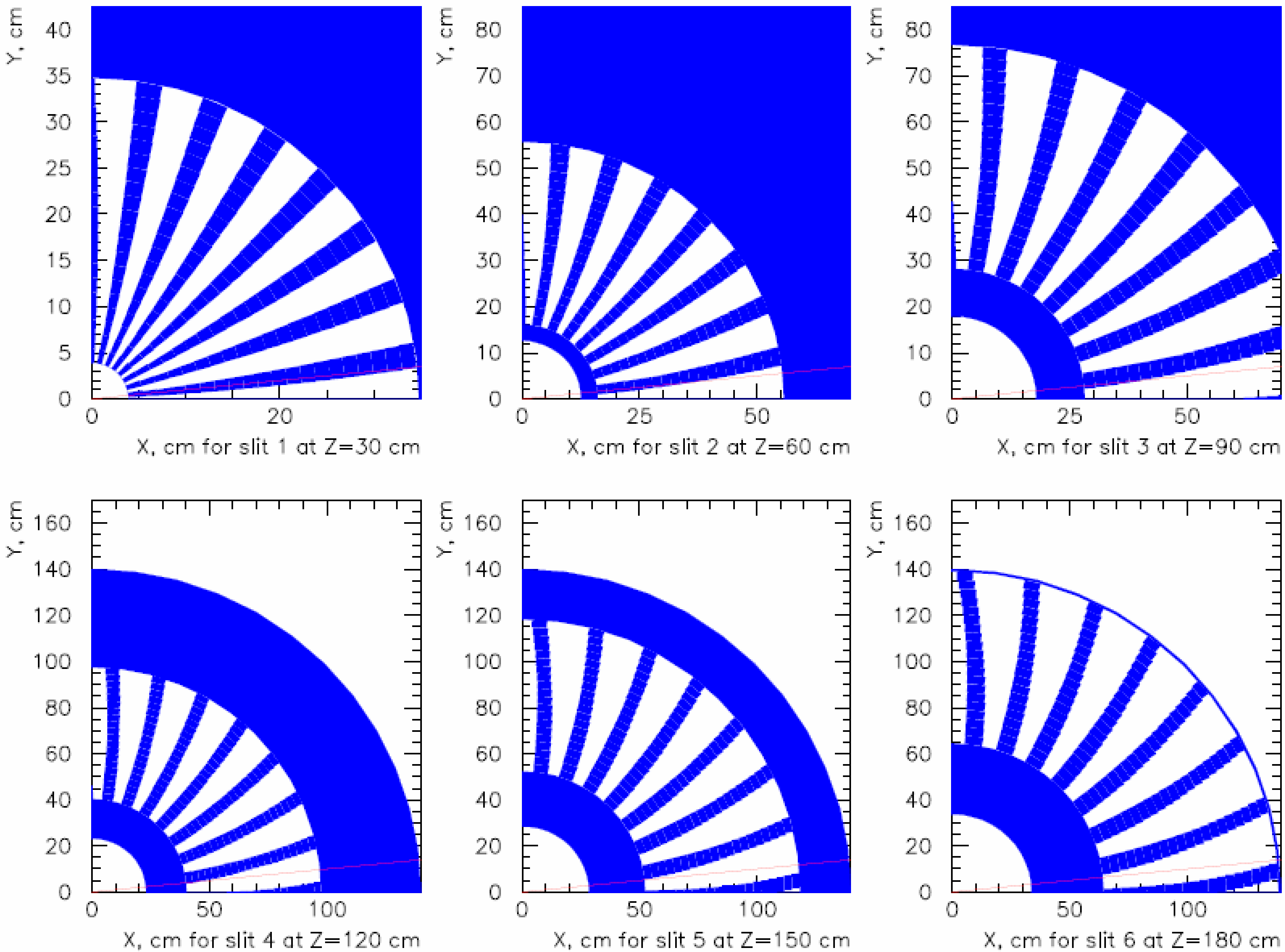


Figure 3.7: The optimized geometry of the baffles.

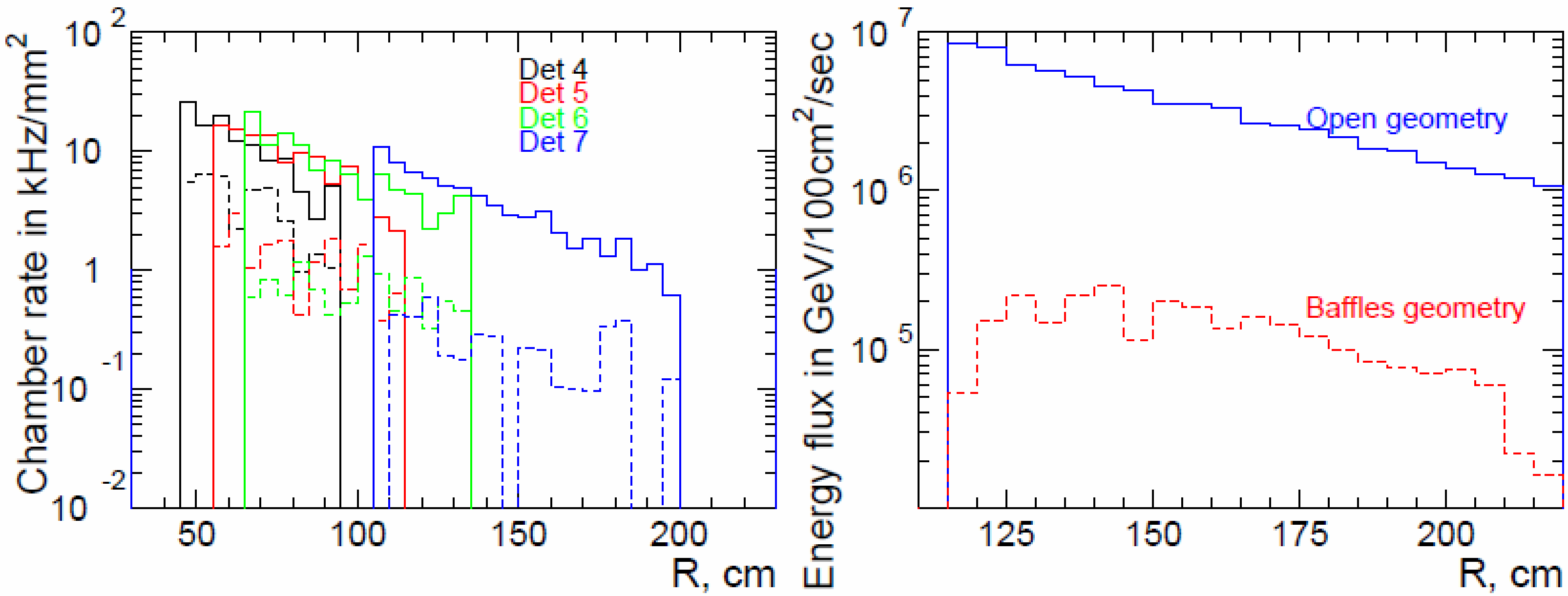


Figure 3.9: Left: the background rate in the coordinate detectors in kHz per mm^2, depending on the radius, without the baffles (the solid lines) and with the baffles (dashed lines). The baffles reduce the rate by a factor of $\sim$10 for the detectors 5-8. Right: the energy flow in the EM calorimeter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

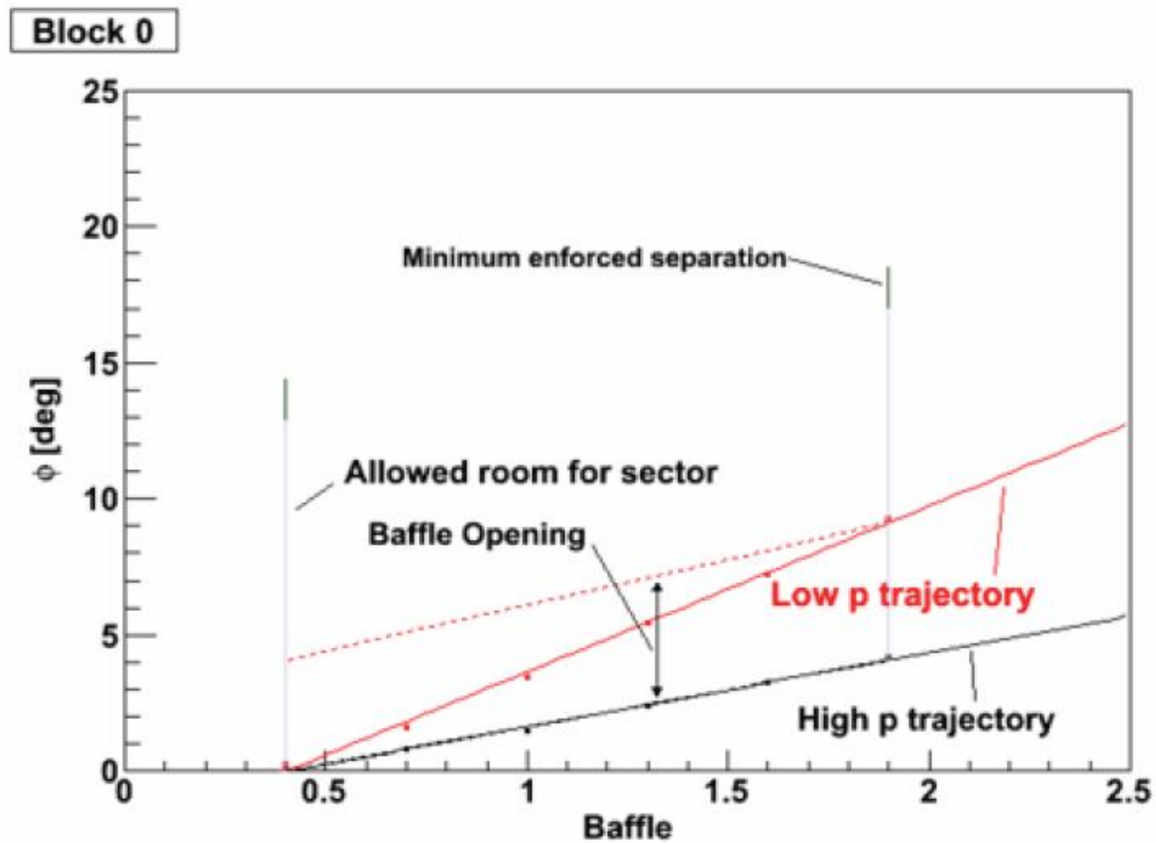


Figure 50: Raytraced electron trajectories used in baffle width design.

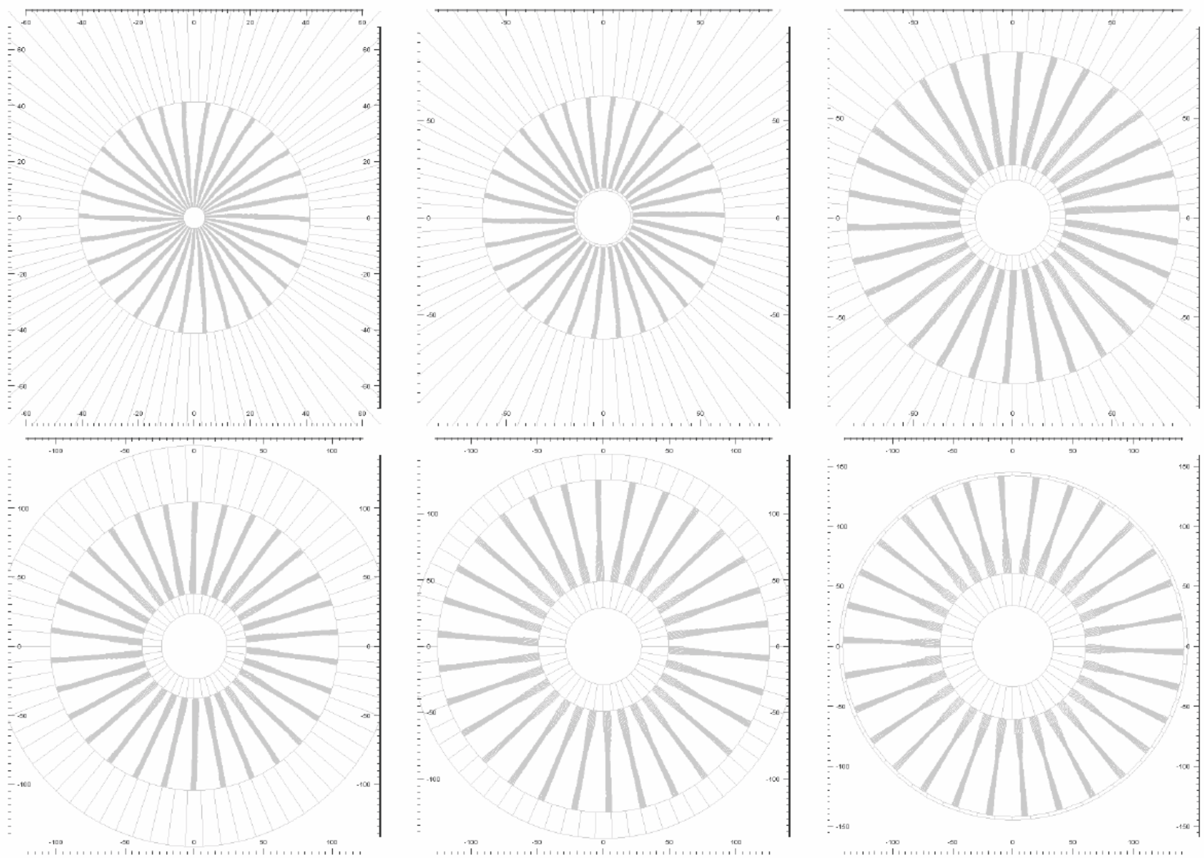


Figure 51: Baffle profiles

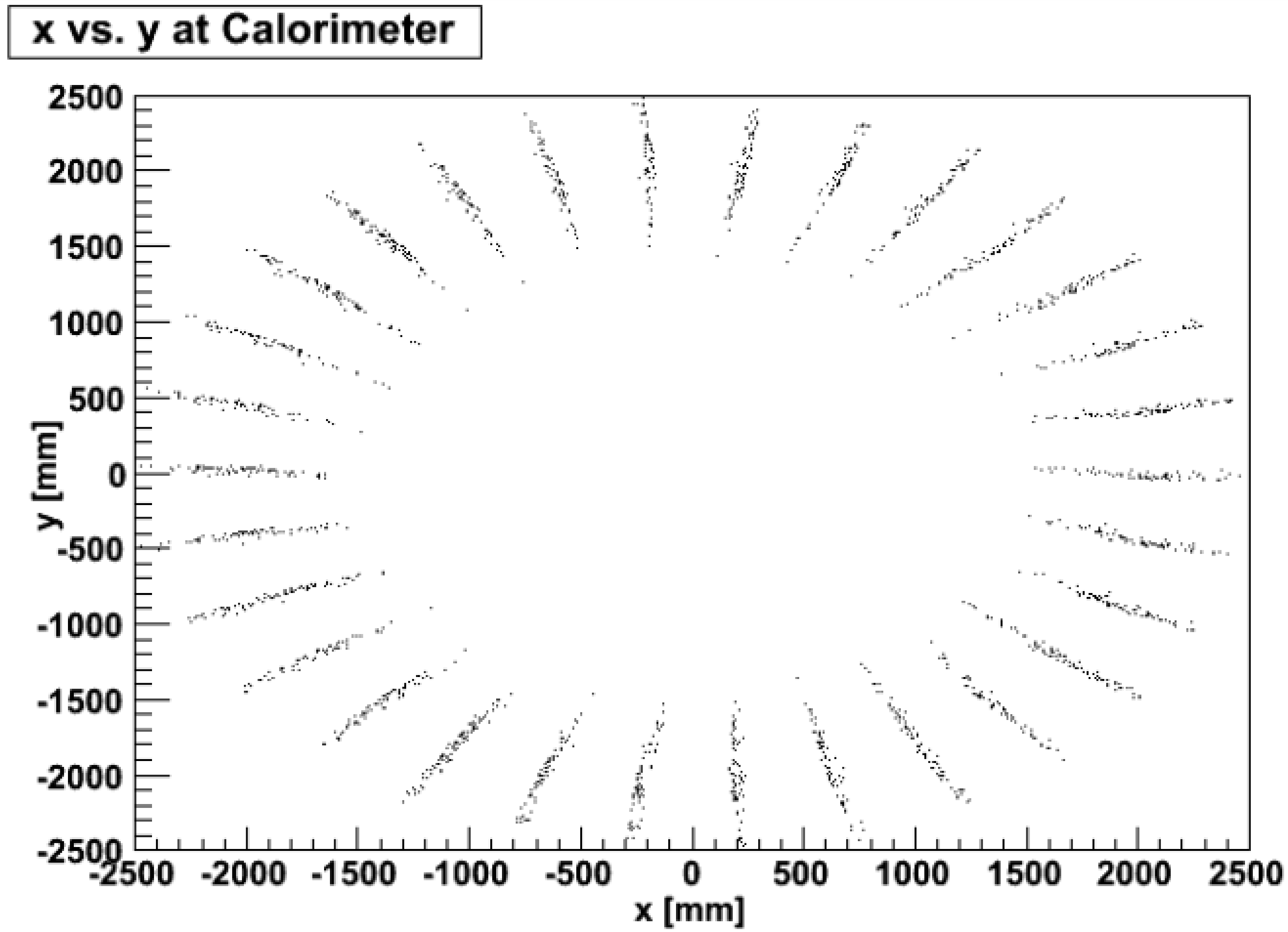


Figure 52: Photons leak through baffles

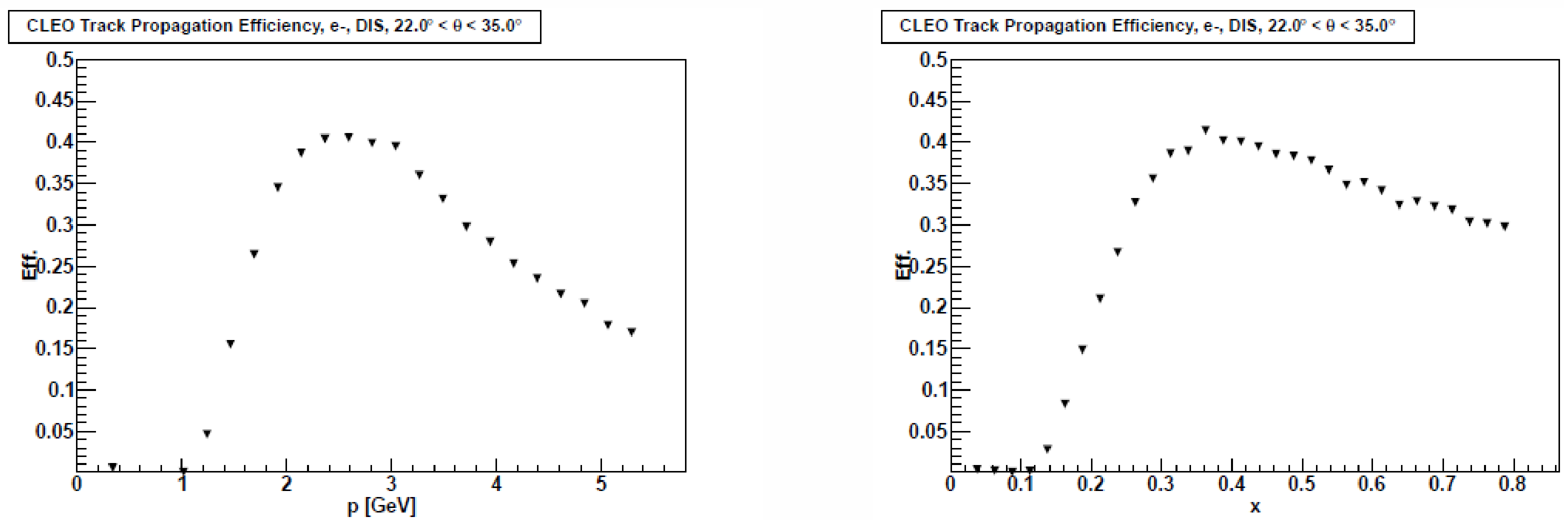


Figure 53: DIS electron propagation efficiencies