Background in a downstream C4F10 Cerenkov detector

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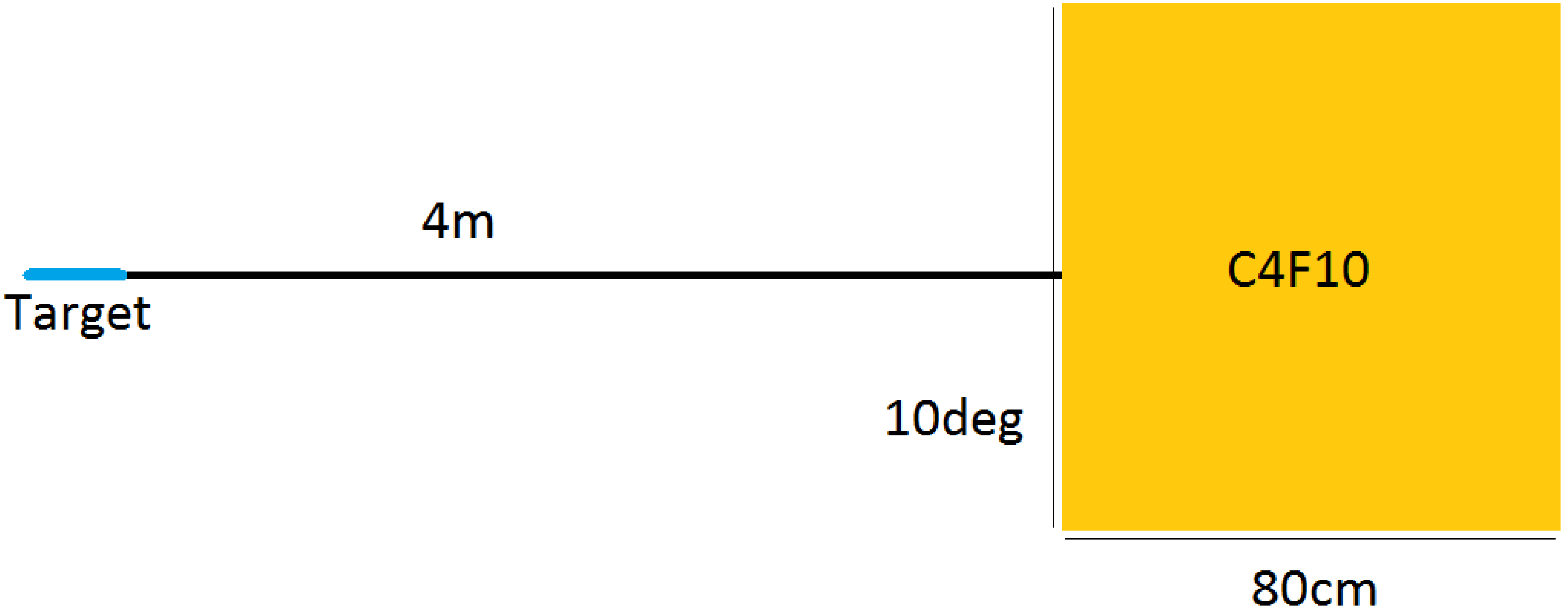
Rough Toy Geometry



Geometry

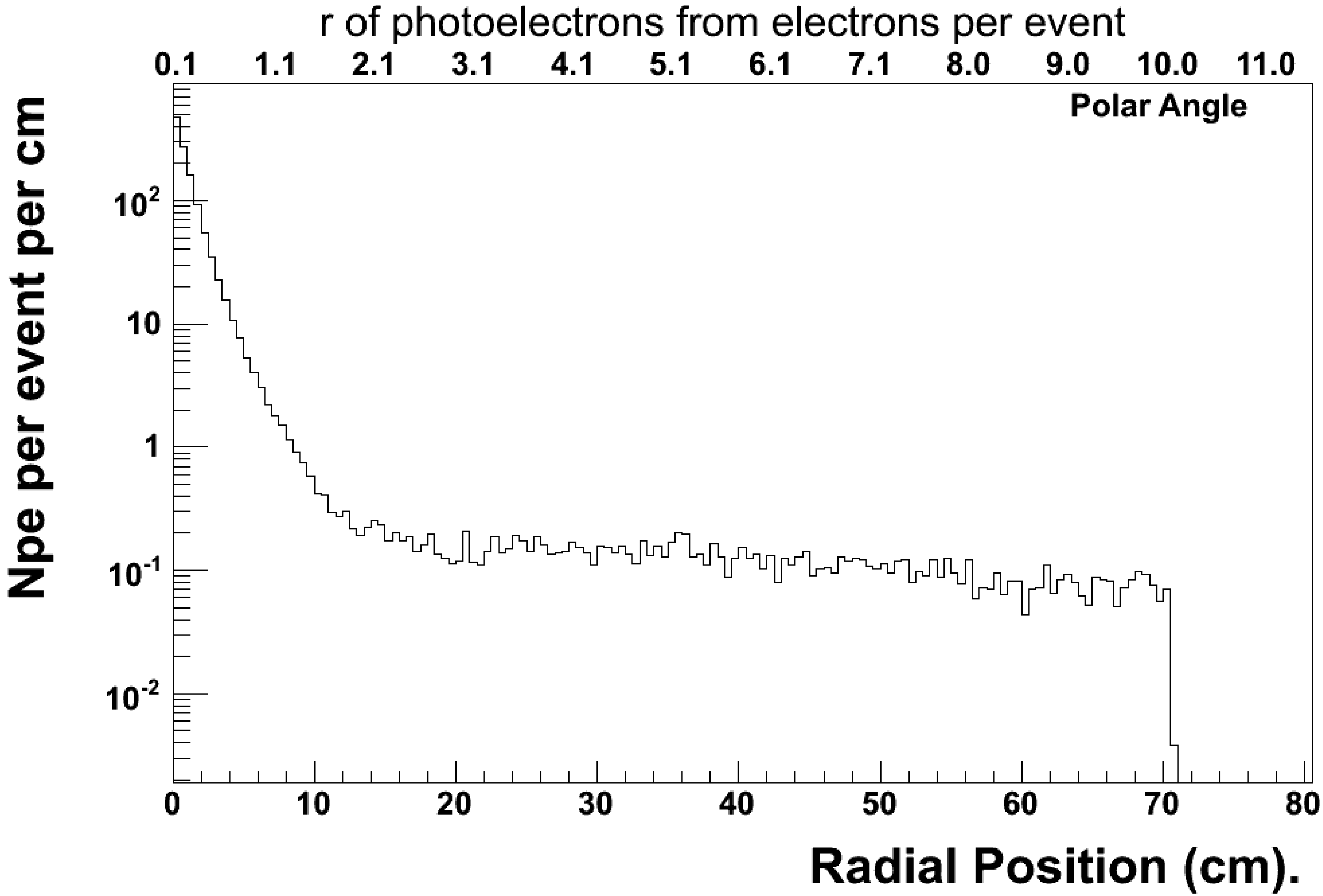
- 80cm and 10° are rough estimates
- 4m from end of target (at 480cm in simulation coordinates)
- Used n=1.0015

Data used

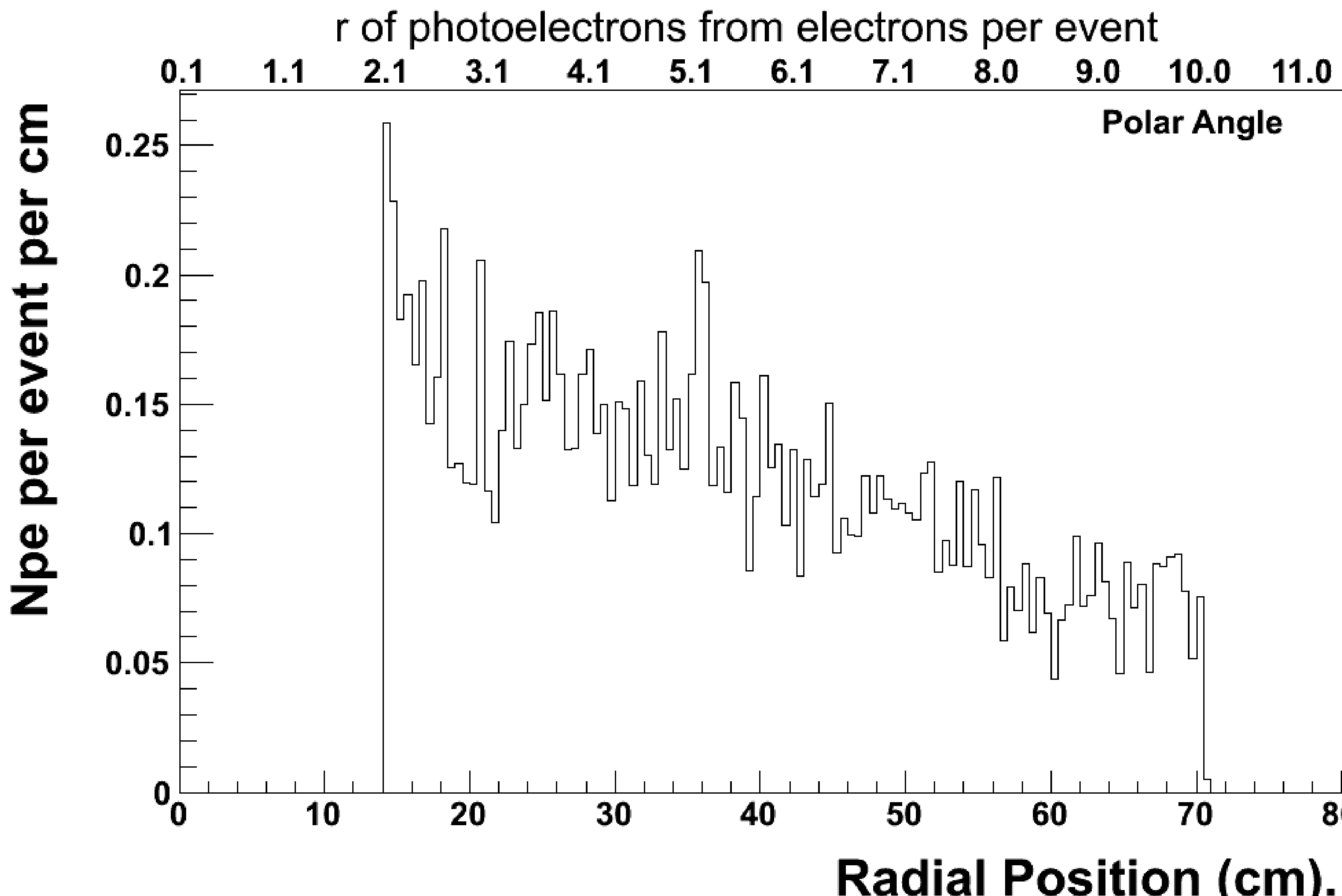
- EM background was turned on
- TRAJECTORIES variable set in bggen
- Used Pythia data
- MCTrajectory points were iterated over
  - Sorted by track ID
  - Followed points into geometry
- MCThrown tracks did not contain all e-'s in MCTrajectory lists

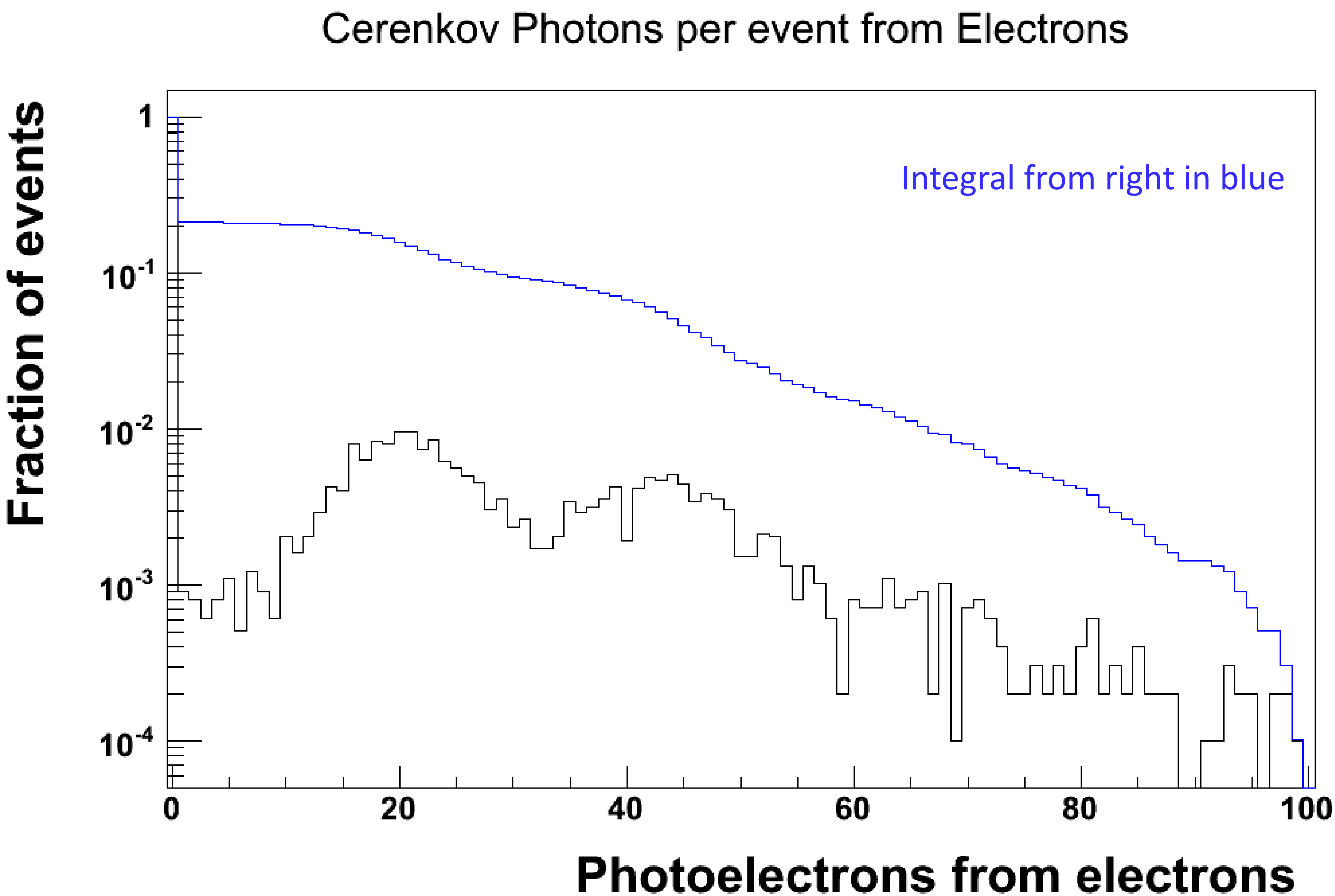
Method

- If points crossed front detector plane, a charged particle was said to have entered the detector
  - N photoelectrons thrown in a Poissonian
    - $mean = 90 * L(cm) * (1 - \frac{1}{(n\beta)^2})$
  - Equation and typical value of 90 from the pdg (ch31)
- First try: full 10^{o}


r of photoelectrons from electrons per event
0.1
1.1
2.1
3.1
4.1
5.1
6.1
7.1
8.0
9.0
10.0
11.0
Polar Angle
Npe per event per cm
10^2
10
1
10^-1
10^-2
0
10
20
30
40
50
60
70
80
Radial Position (cm).

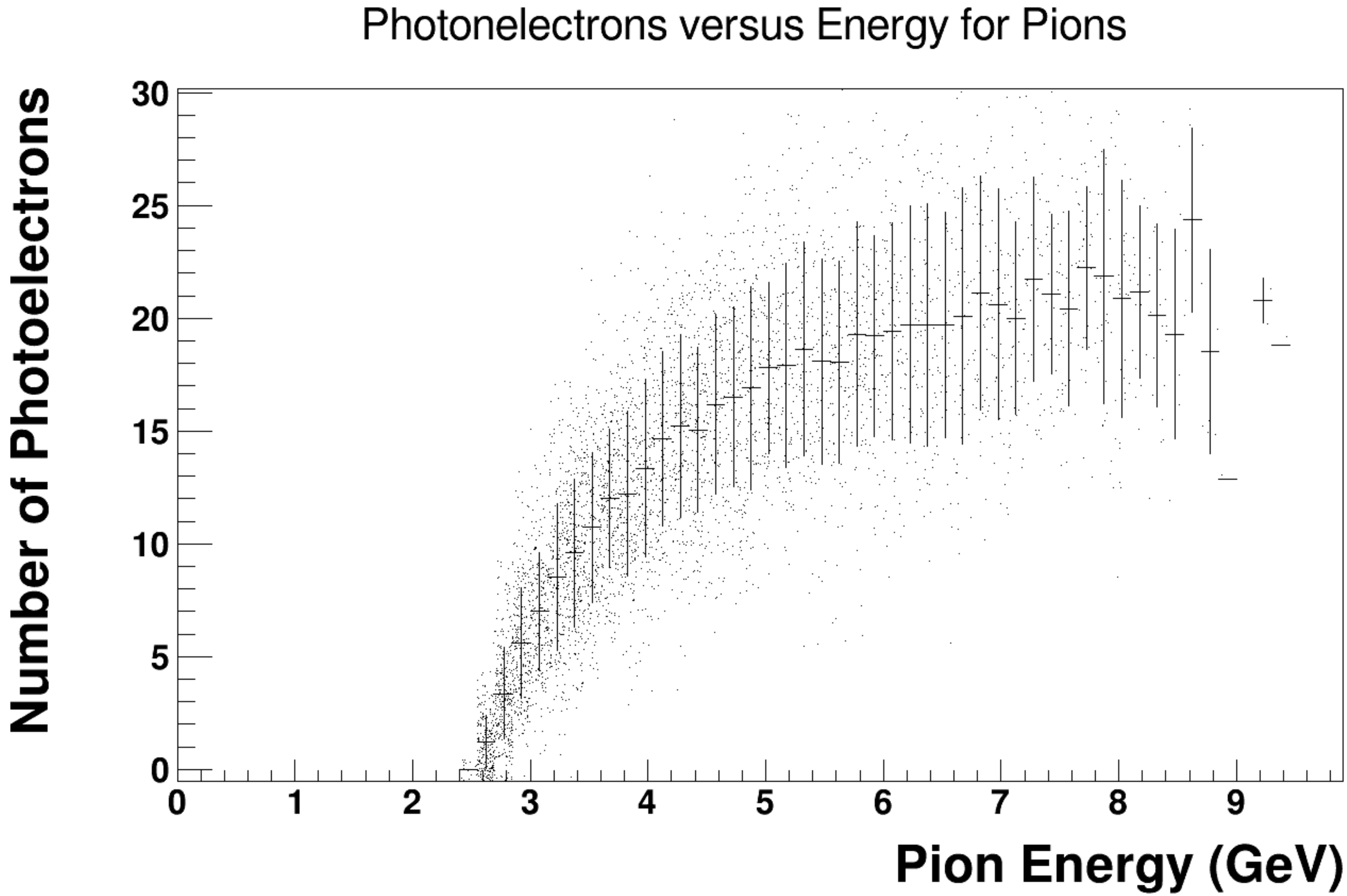
- Way too many photo electrons.
- Flattens out at 14cm or ~2^{o}
  - Try a hole in the detector here.
- Examine total photoelectrons per event
  - With cut at 14cm=2^{o} : mean=6.8
  - With cut at 7cm=1^{o}: mean=11.0
  - Without cut: mean ~600


r of photoelectrons from electrons per event
0.1
1.1
2.1
3.1
4.1
5.1
6.1
7.1
8.0
9.0
10.0
11.0
Polar Angle
Npe per event per cm
0.25
0.2
0.15
0.1
0.05
0
0
10
20
30
40
50
60
70
80
Radial Position (cm).

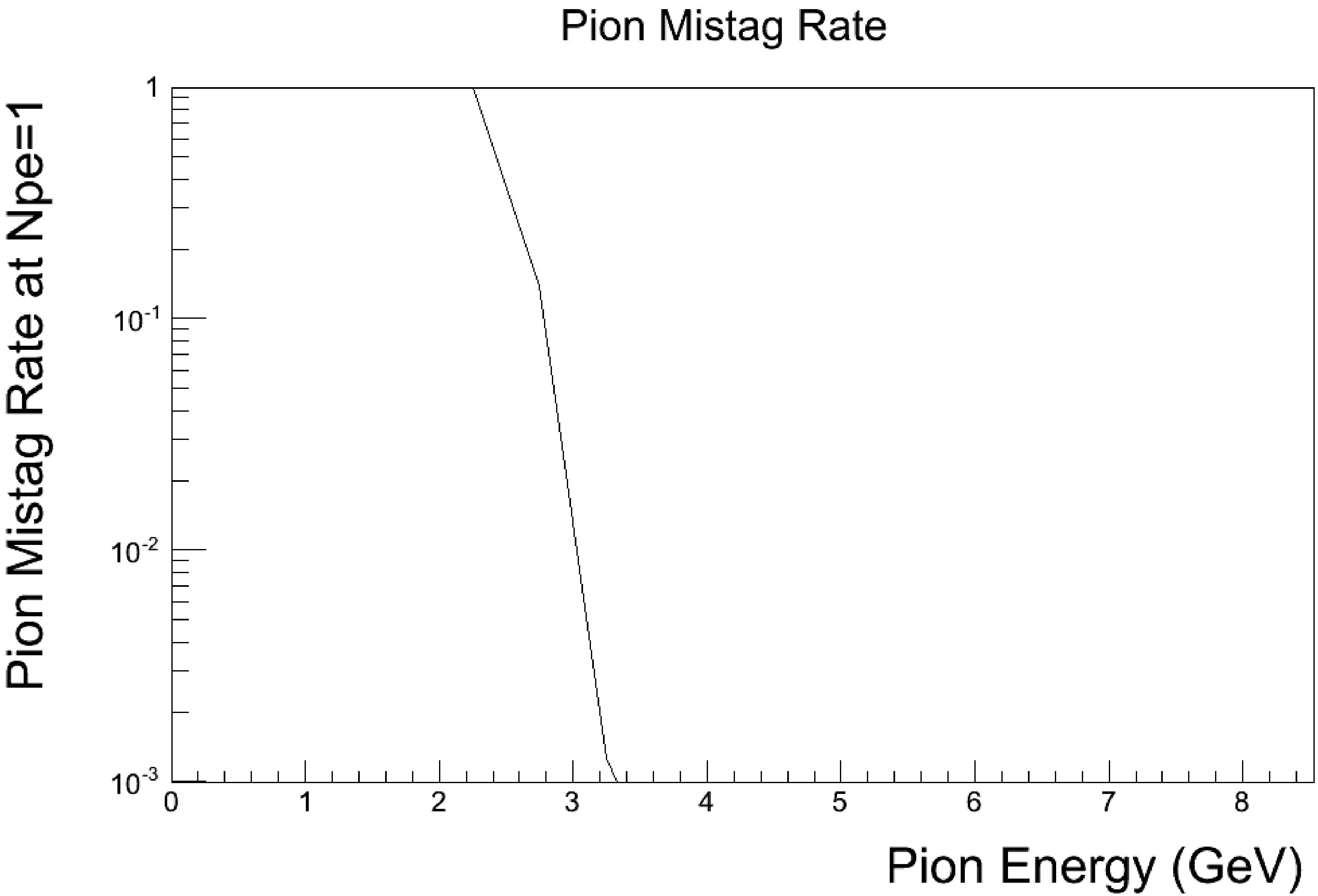

Cerenkov Photons per event from Electrons
Integral from right in blue
Fraction of events
1
10^{-1}
10^{-2}
10^{-3}
10^{-4}
0
20
40
60
80
100
Photoelectrons from electrons

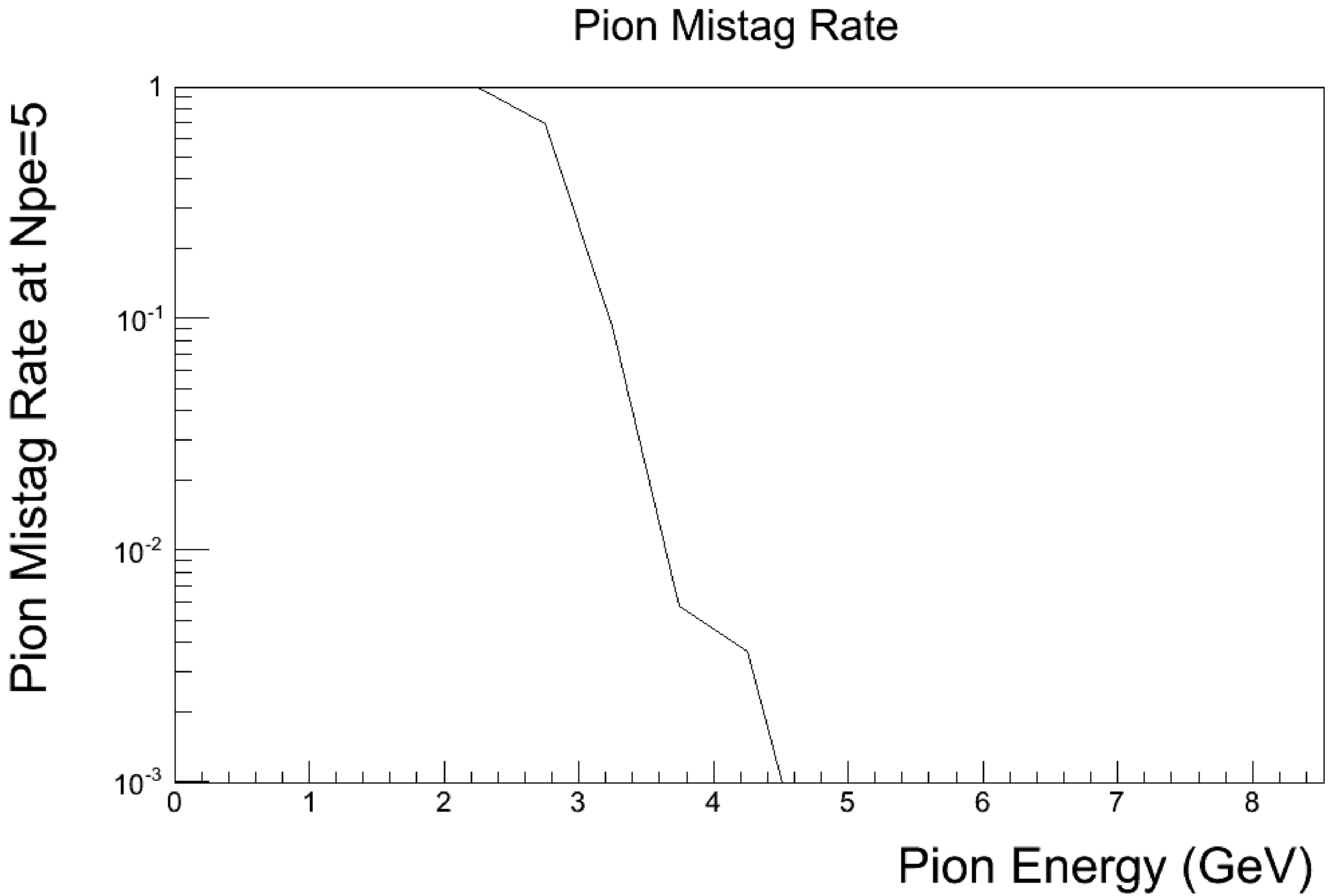
Background

- Small on average
- Bimodal: 0 or 20 as two peaks
  - Also, weak peak around 40 from 2 e-
- What about pion signal
  - Look at photoelectrons versus energy
  - Compare Photoelectrons at various energy
  - Look at mistag rate



Photonelectrons versus Energy for Pions
Number of Photoelectrons
Pion Energy (GeV)
0
5
10
15
20
25
30
0
1
2
3
4
5
6
7
8
9


Pion Mistag Rate
Pion Mistag Rate at Npe=1
1
10^{-1}
10^{-2}
10^{-3}
0
1
2
3
4
5
6
7
8
Pion Energy (GeV)


Pion Mistag Rate
Pion Mistag Rate at Npe=5
1
10-1
10-2
10-3
0
1
2
3
4
5
6
7
8
Pion Energy (GeV)

Conclusions

- Need 1 photoelectron to veto ~99% of pions above 3 GeV.
  - 5 photoelectrons would move it to above 4 GeV
- More material would improve the energy cut off
  - Mean and stdDev expected to grow linearly with material depth.
- 21% of events have an electron
  - For 1 segment, this is the rate at which Kaons are misIDed
  - MisID roughly independent of Npe cut