Performance requirements

High-Level Key Performance Parameters (KPP)

Pointing resolution of HFT system (750 MeV/c kaons)	≤60 μm in the r-phi plane
Single-track efficiency for HFT system , requiring PXL hits on both layers. (1 GeV/c pions)	≥ 60%

•The high-level KPPs cannot be directly measured without beam. The capability to achieve these parameters can be demonstrated at CD-4 through the measurement of the low-level KPPs plus simulation studies using the full STAR detector simulation package and analysis software.

Low-level CD-4 KPPs

Experimentally demonstrated before installation:

1	Transverse thickness of first PXL layer	< 0.65% X_0
2	Internal alignment of sensors on a ladder of PXL.	< 30 μm
3	Internal stability of PXL sector	< 30 μm
4	Relative Stability of ISD and SSD relative to PXL layer	< 300 μm
5	PXL integration time	< 200 μs
6	Detector hit efficiency and pixel noise- PXL	> 95% sensor efficiency and noise level < 10-4
7	Detector hit efficiency - IST	> 95% from Signal: Noise better than 10:1
81	Live channels for PXL and IST	> 85%
9	PXL and IST Readout speed and dead time	<5% additional dead time at 500 Hz average trigger rate and simulated occupancy
10	SSD dead time	< 10% at 500 Hz

The achievement of the low-level KPPs will be proven through bench tests, survey measurements and the meeting of design specifications (Appendix A of PEP)

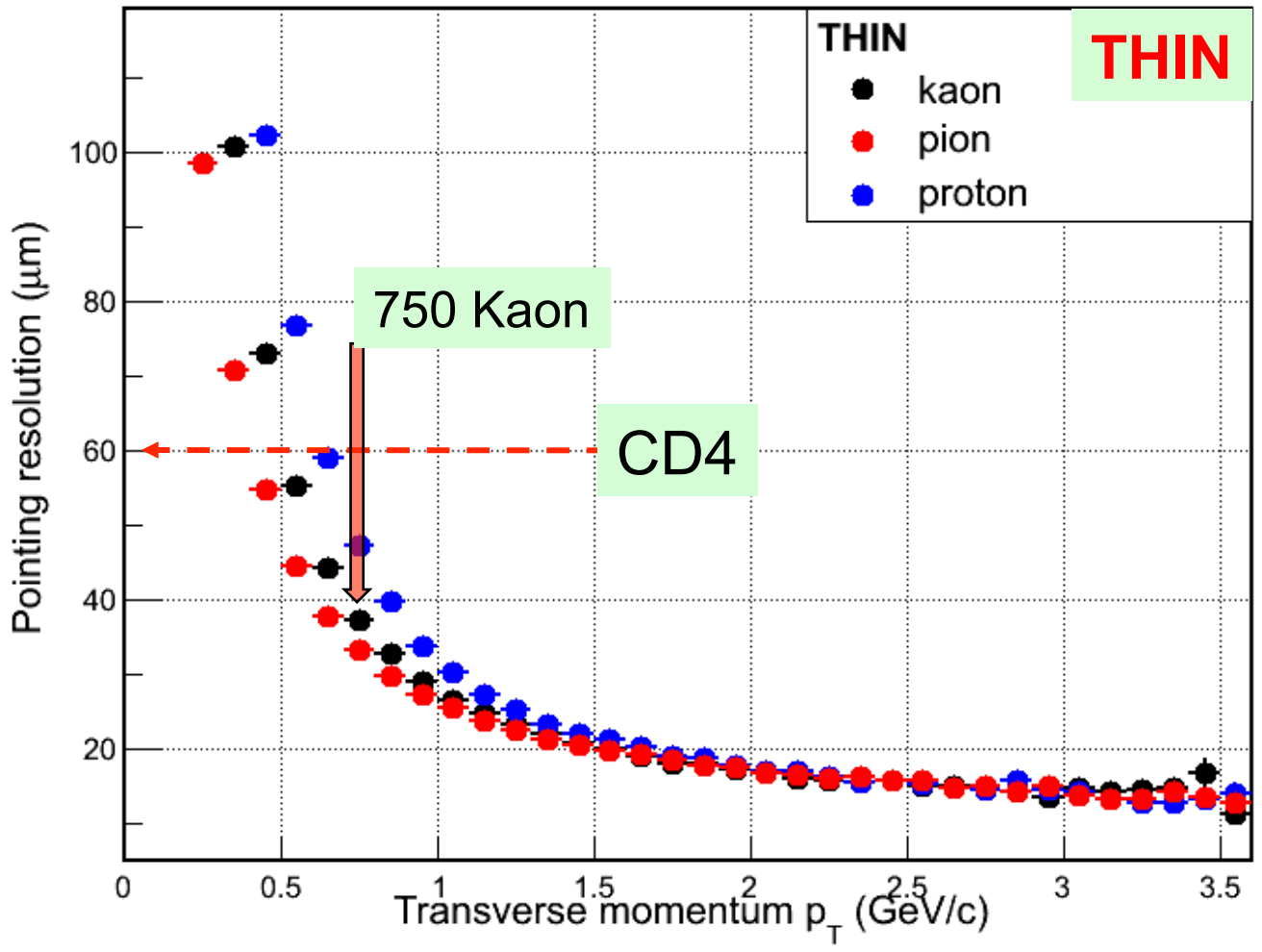
Will be addressed in sub-system talks

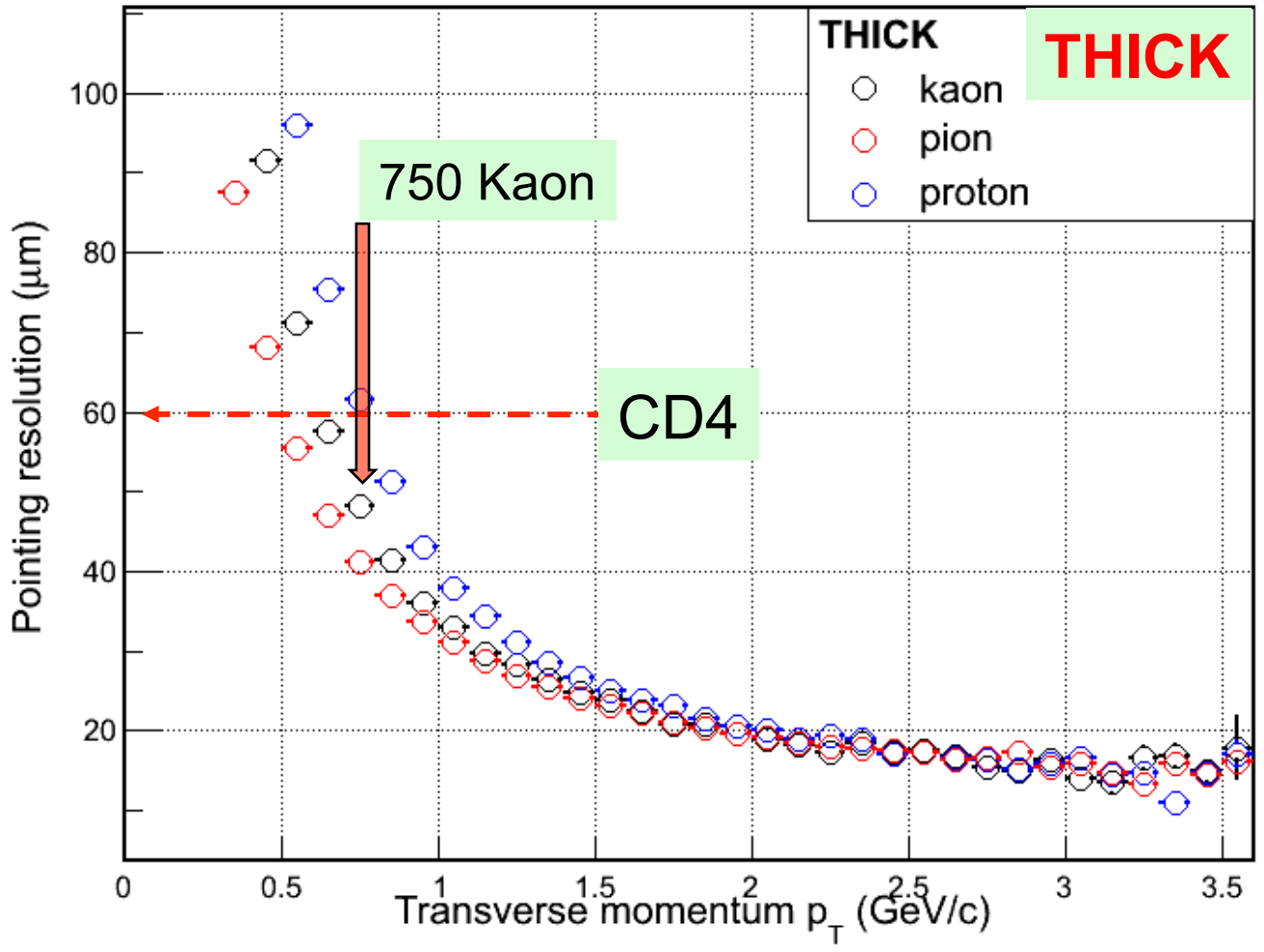
Parameters can be demonstrated and documented before final assembly and installation of HFT in the STAR detector.

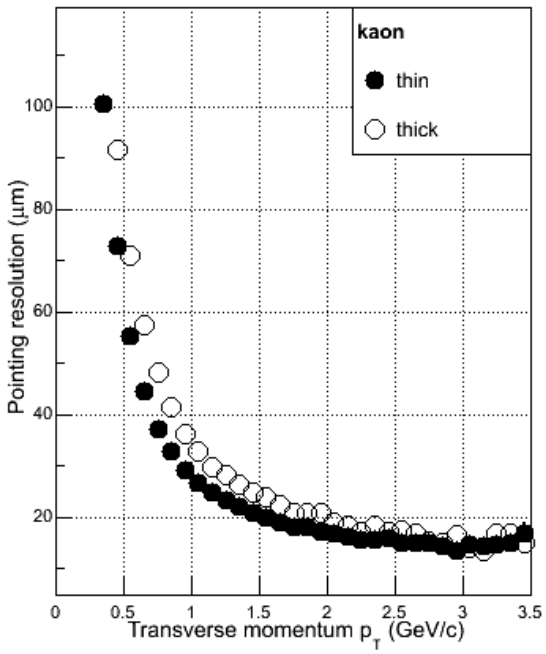
Pointing resolution

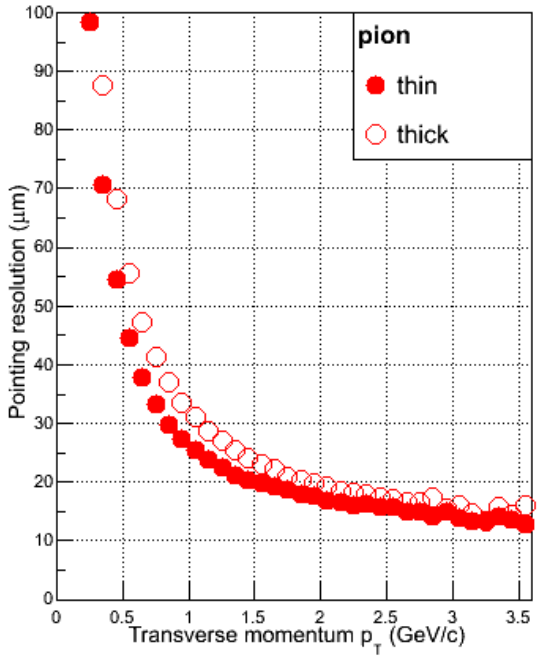
- I used the rectrees made by Yifei.
- It used minimc files ,so it has the matching GEANT and reco
  - Therefore there is the particle Id so that I have plotted the **dcaXY** (r-phi) for kaon, pion, proton with perfect PID
- Run over the 10k for both THIN and THICK (the rectrees were already done)
- Cuts : RcHitsPxl == 2, RcNHits >15
- There is a root file with the raw histograms (both TH2D and fitSlices() for kaon, pion, proton, THIN and THICK at : /star/institutions/ksu/bouchet/THICK_HFT/ANA_RECTREE/RETEST/comparison_thick_thin_cd1.root

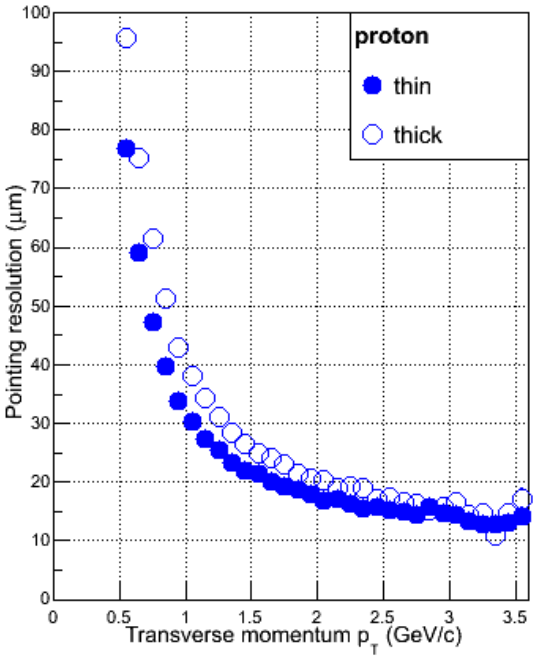
Pointing resolution of HFT system (750 MeV/c kaons)	≤60 μm in the r-phi plane



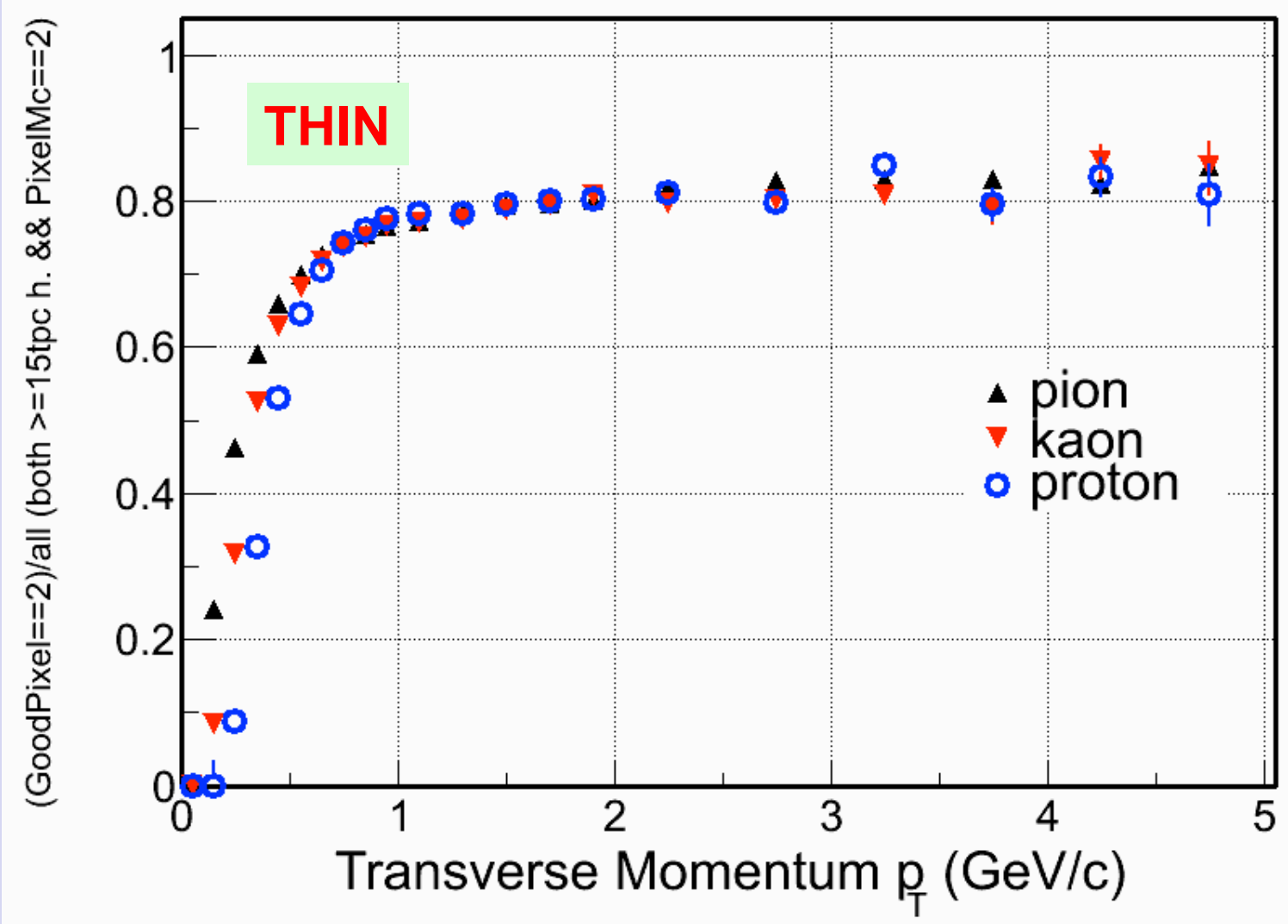

THICK
kaon
pion
proton
THICK
750 Kaon
CD4
Pointing resolution (μm)
100
80
60
40
20
0
0.5
1
1.5
2
2.5
3
3.5
Transverse momentum p_T (GeV/c)


kaon
thin
thick
Pointing resolution (μm)
Transverse momentum p_T (GeV/c)

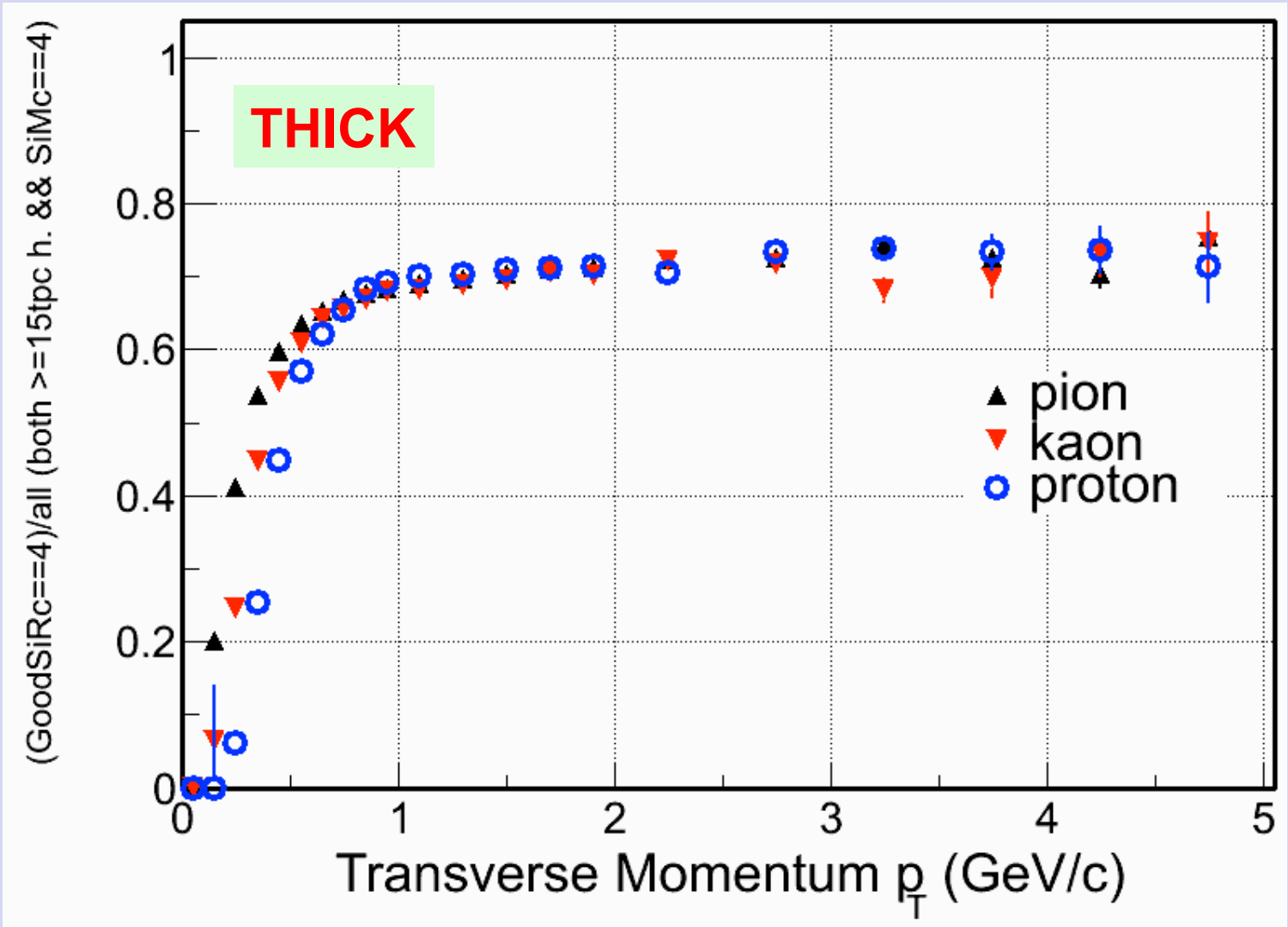

pion
thin
thick
Pointing resolution (μm)
Transverse momentum p_T (GeV/c)

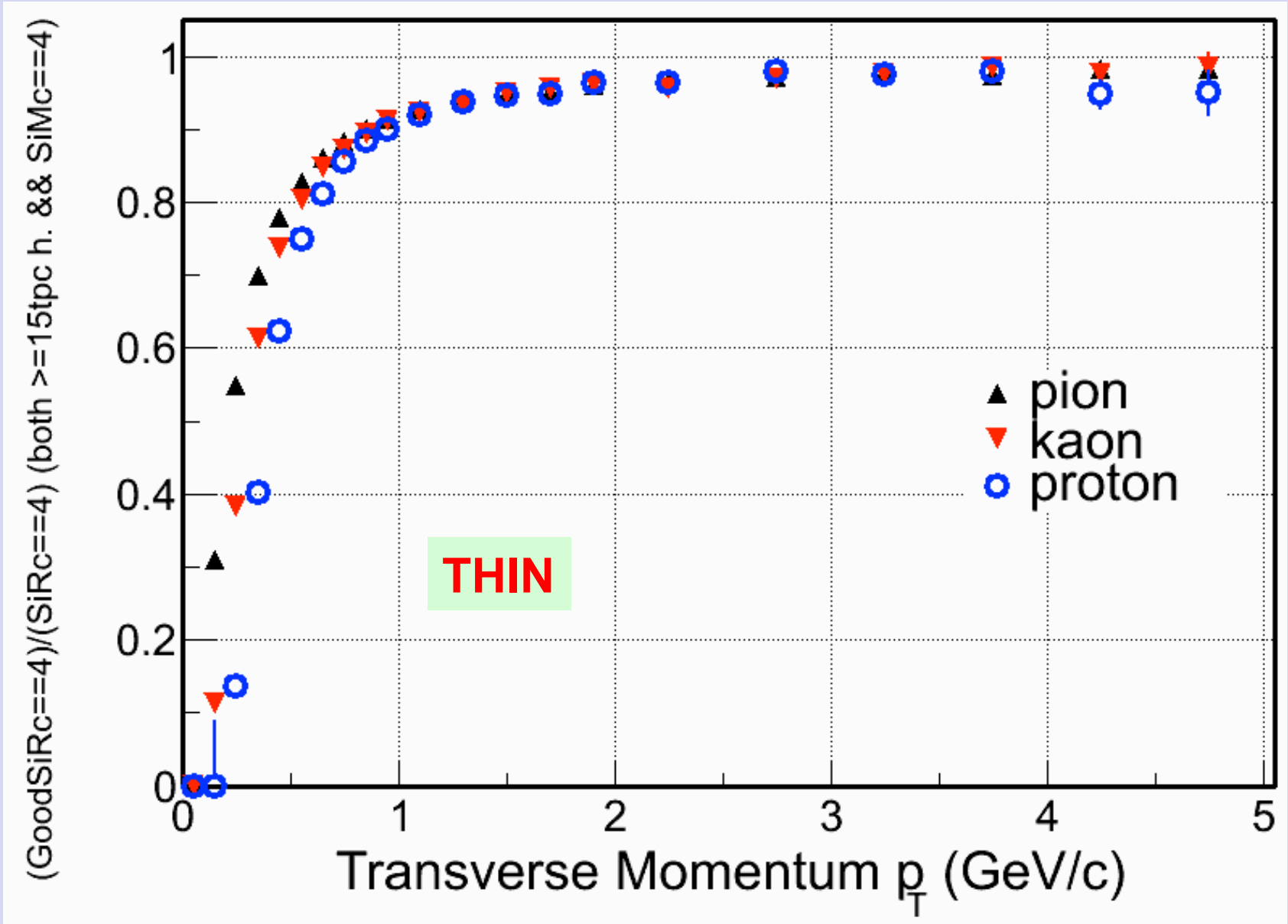

proton
thin
thick
Pointing resolution (μm)
Transverse momentum p_T (GeV/c)

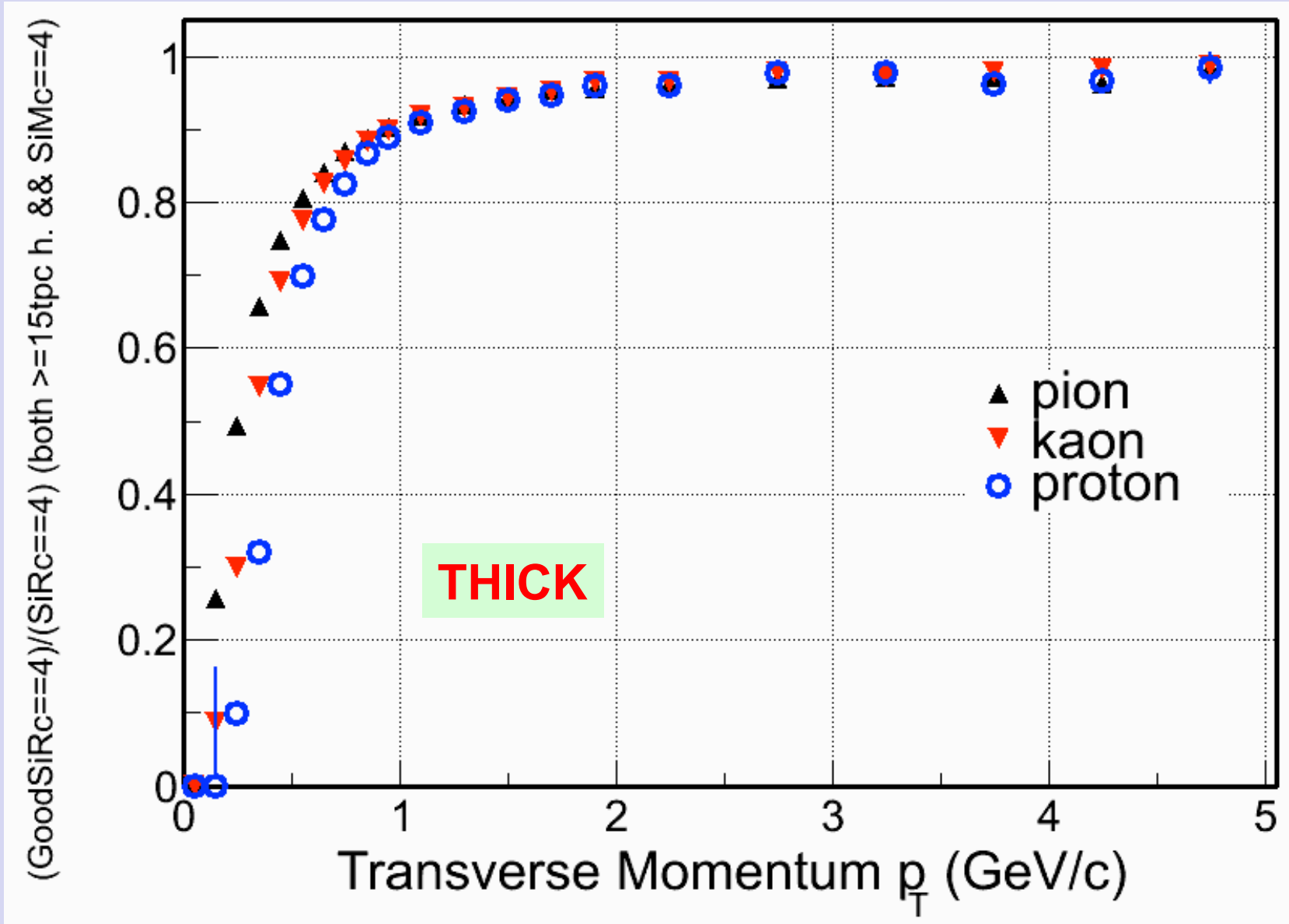
Single-track efficiency for HFT system , requiring PXL hits on both layers. (1 GeV/c pions)	≥ 60%



Single-track efficiency for HFT system , requiring PXL hits on both layers. (1 GeV/c pions)	≥ 60%




(GoodSiRc==4)/(SiRc==4) (both >=15tpc h. && SiMc==4)
1
0.8
0.6
0.4
0.2
0
0
1
2
3
4
5
Transverse Momentum p_T (GeV/c)
pion
kaon
proton
THIN


(GoodSiRc==4)/(SiRc==4) (both >=15tpc h. && SiMc==4)
1
0.8
0.6
0.4
0.2
0
0
1
2
3
4
5
Transverse Momentum p_T (GeV/c)
pion
kaon
proton
THICK

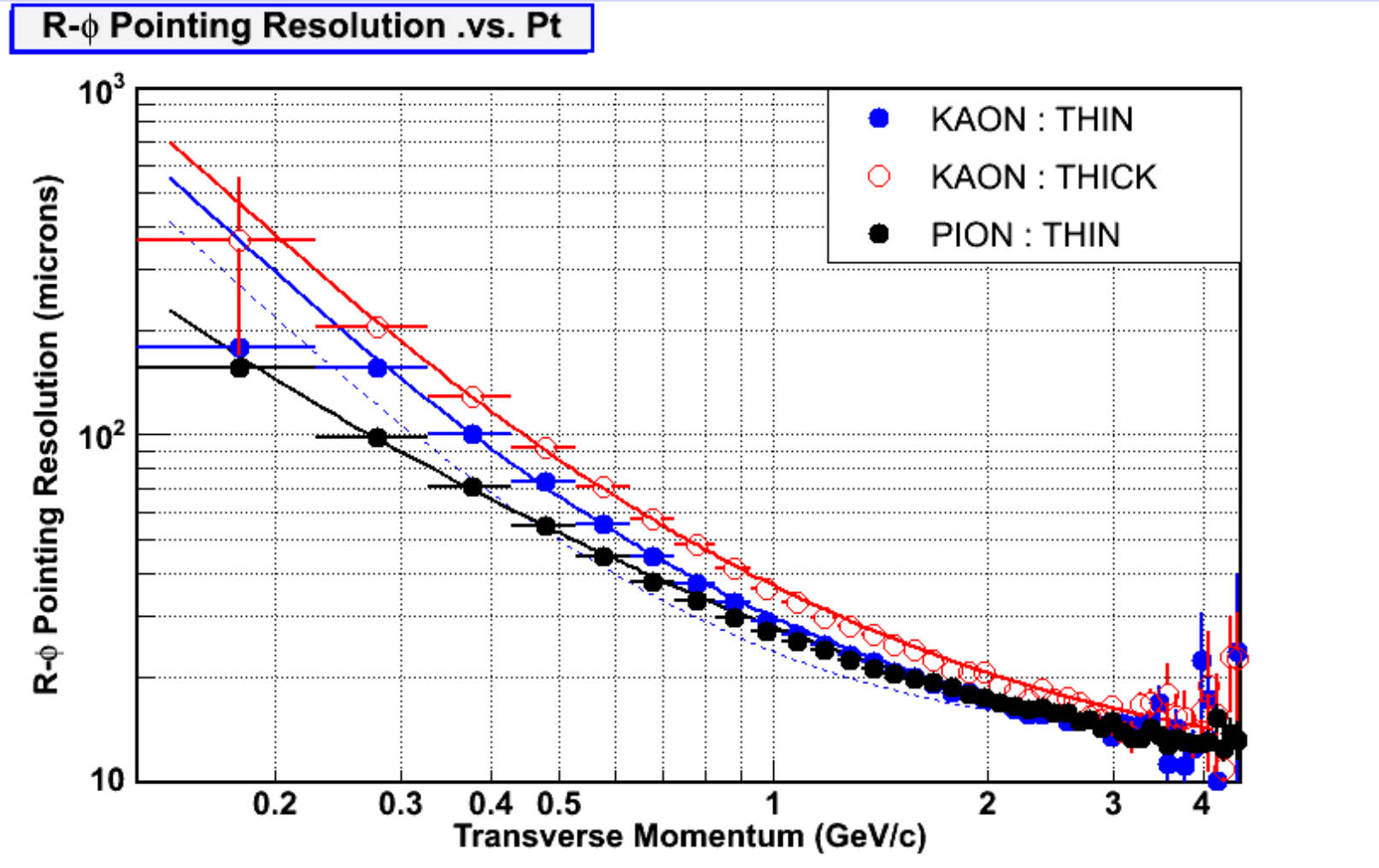
- These plots are for DEMO purposes of course
- Once we have the final system in place with ACTUAL thickness and ACTUAL dead areas etc known, the simulations need to be repeated in order to extract the final numbers and THEN see if comply with CD4

BACKUP

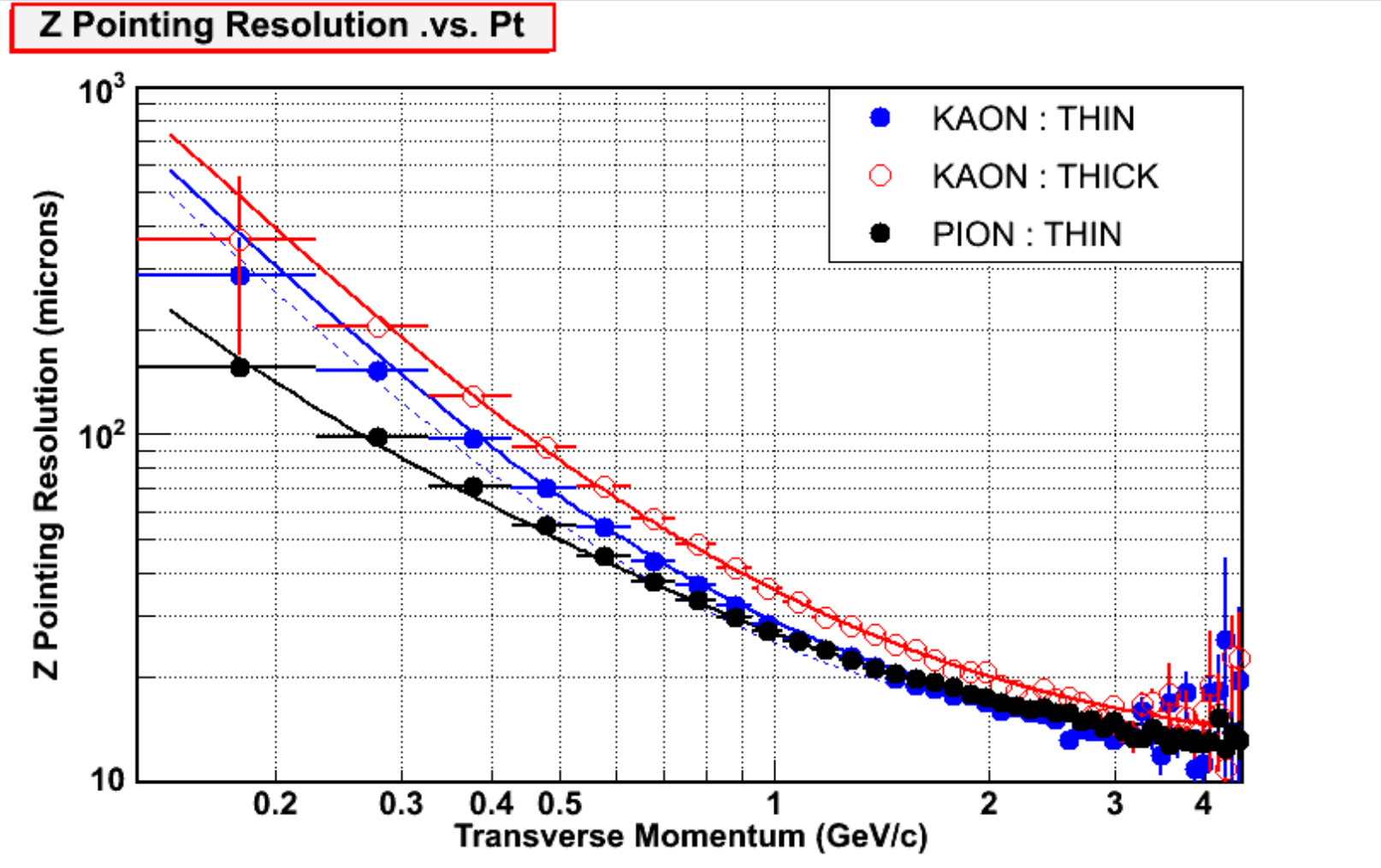
Thin-thick DCA

- Files used :
  - Rectree:
    - /star/u/yfzhang/lbl/hft/upgr15/cd1/production/thin/particle/ntuple/out/
    - 20 D0, 30 Ds /evt with power-law pt, 30 Lc /evt with flat pt (fz) + Hijing AuAu Central fz
  - DCA XY and Z reconstructed using StPhysicalHelixD
  - Reconstructed DCA of particles (K,pi,P) are matched with their geant_id = “perfect id”
  - Cuts : Pixel hits requirement =2 ; TPC hits reco. > 15

Pointing resolution in r/phi



Pointing resolution in Z



note

- We reached an agreement btw data and hand calculations of Jim Thomas when the "log" term wasn't used in the MCS definition

$$\sigma^2 = \frac{\sigma_1^2 r2^2 + \sigma_2^2 r1^2}{(r_2 - r_1)^2} + \frac{\theta_{mcs}^2 r_1^2}{\sin^2(\theta)}$$

$$\theta_0 = \frac{13.6\ \text{MeV}}{\beta c p}\, z\, \sqrt{x/X_0}\left[1 + 0.038 \ln(x/X_0)\right]$$