Expected performance using Mathematica

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Content

- **Aim: evaluate bending effect with Mathematica code at:**

  (a) $\theta_{dip} = 90^o$

  (b) $\theta_{dip} = 86^o$

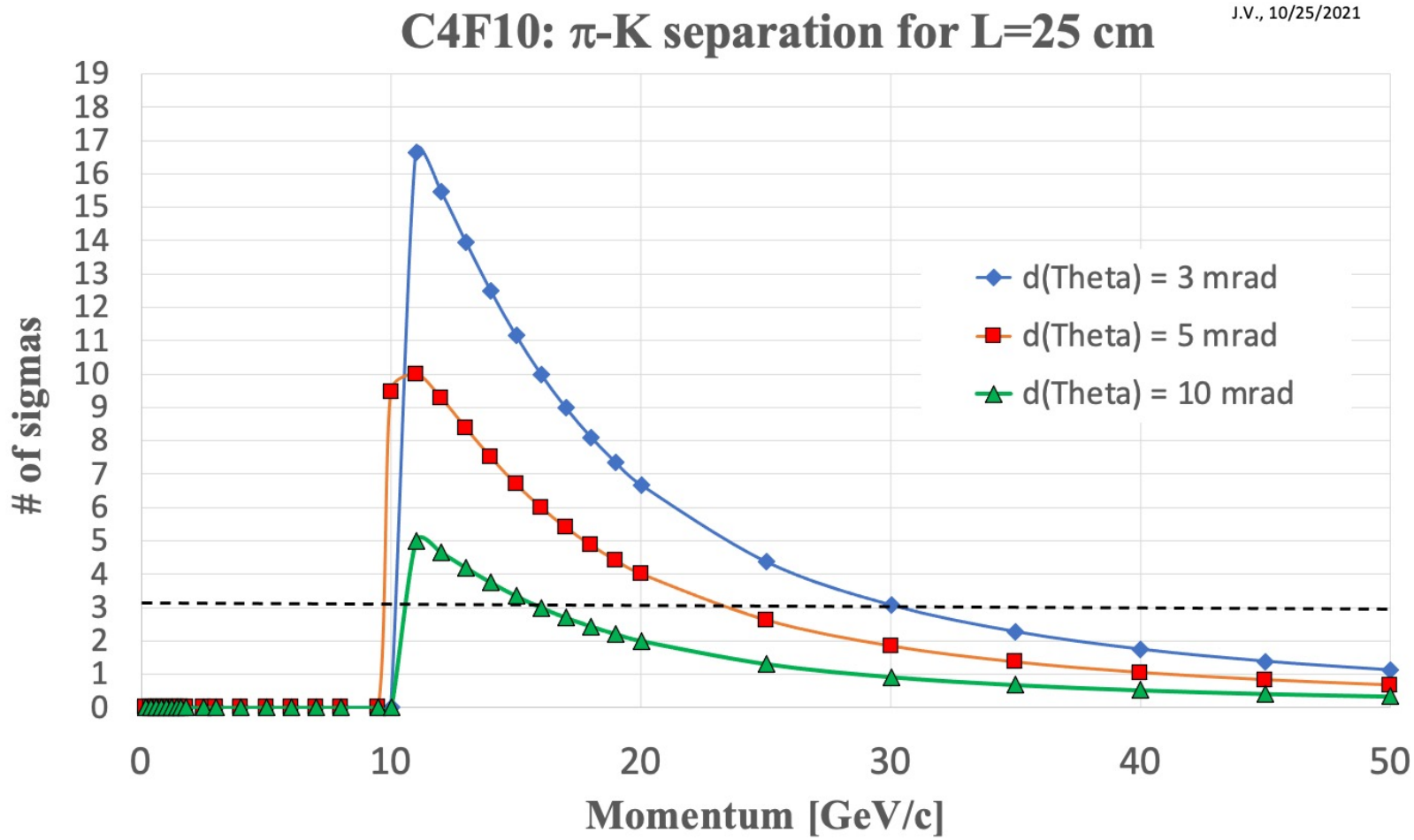
  (c) $\theta_{dip} = 70^o$

This note presents just an initial estimate. Probably many errors still.

SiD: PID performance = f(momentum,σ_θ)

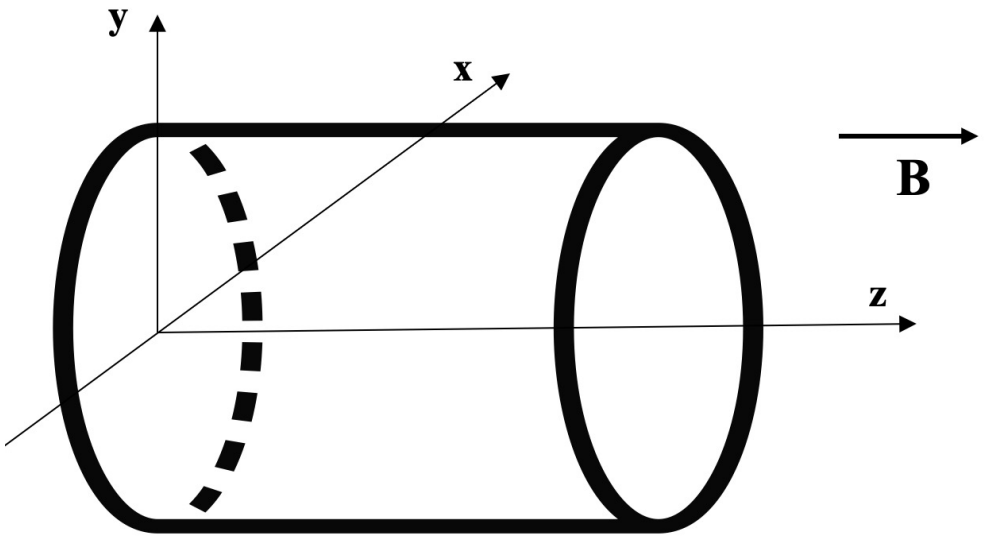
$$\#\ \text{of sigmas} = \frac{\theta_\pi - \theta_K}{\sigma_\theta / \sqrt{N}}$$

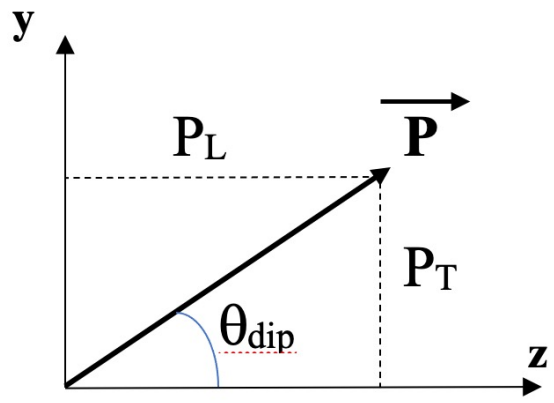
σ_θ is total Cherenkov angle resolution

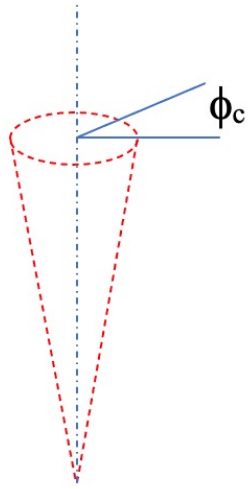


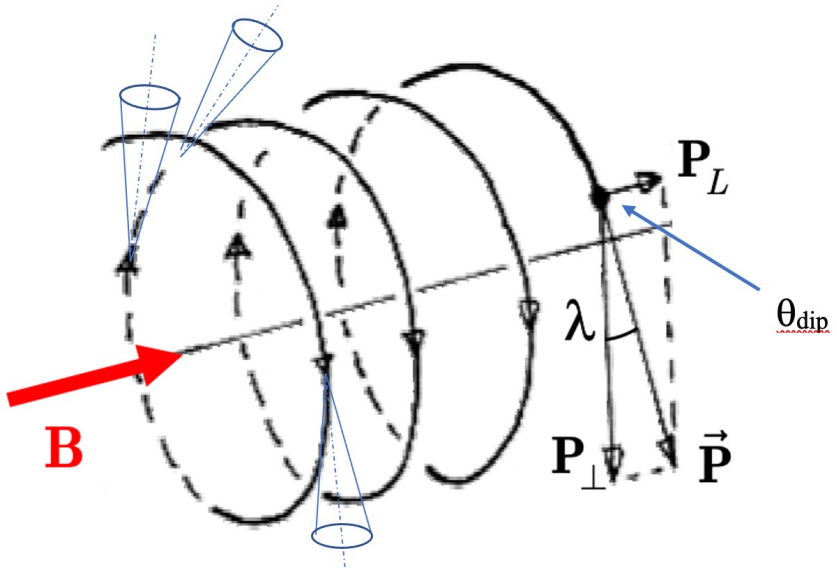
- **Goal: One should not exceed Cherenkov error above ~5 mrads !!**

Some definitions





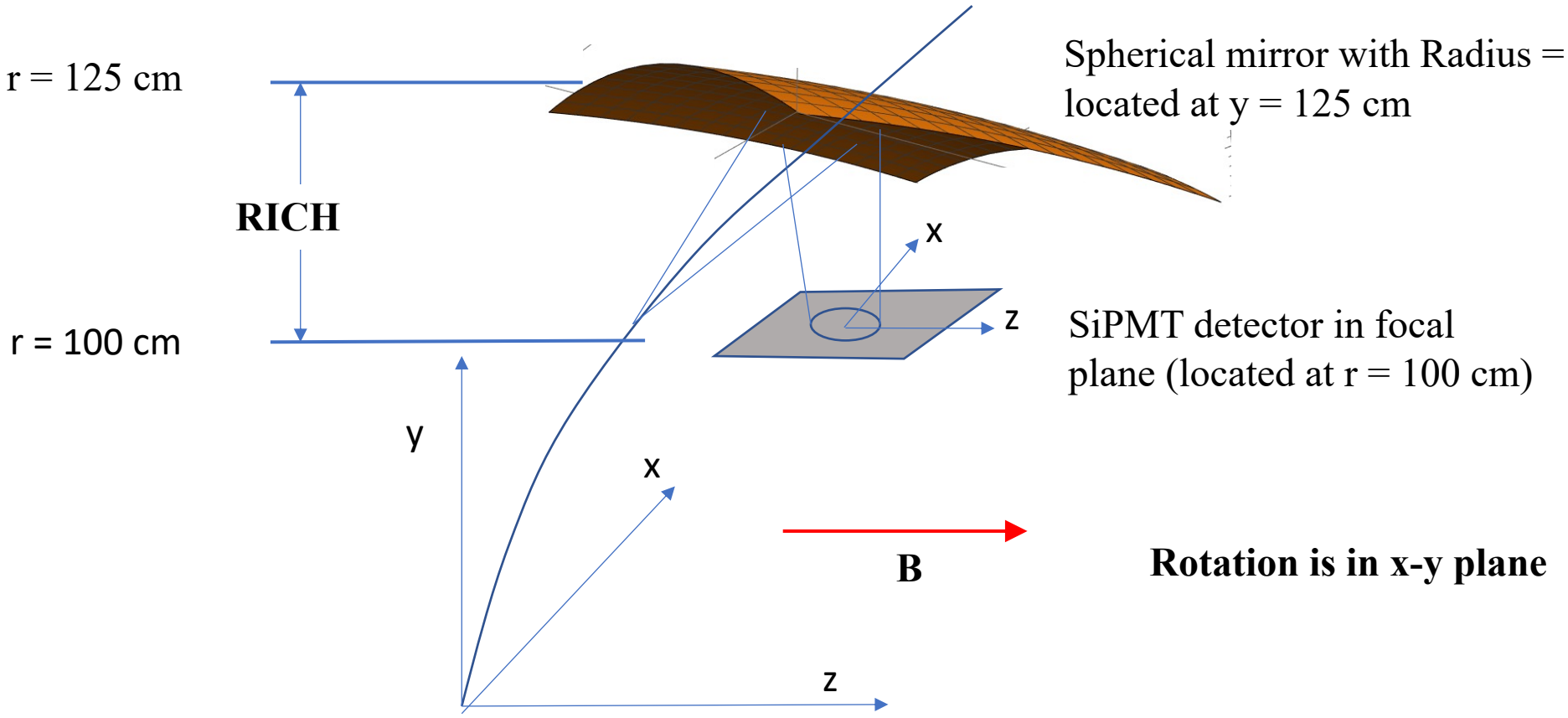




- **Cherenkov cone rotates in 3D !**

Problem to solve in Mathematica

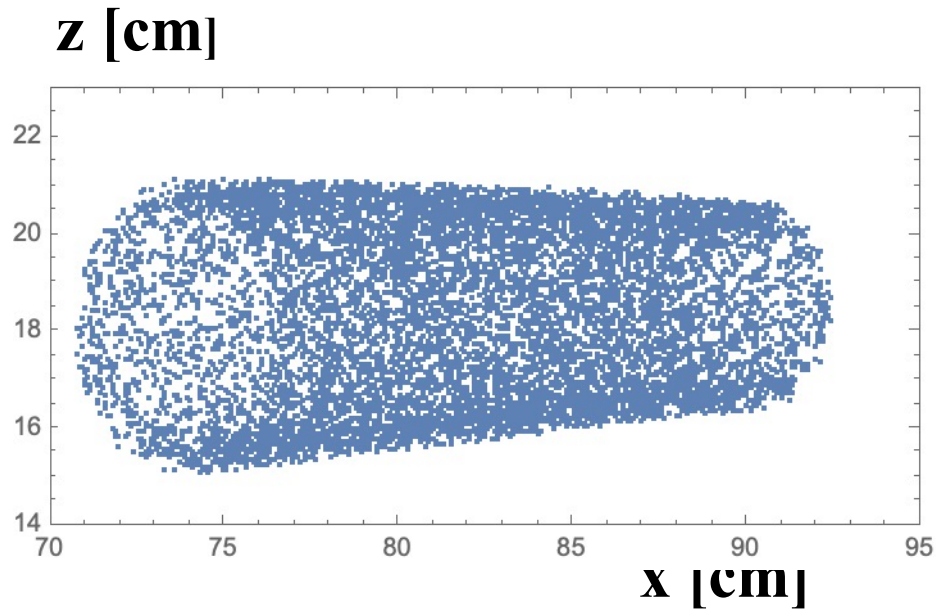
Schematic picture:

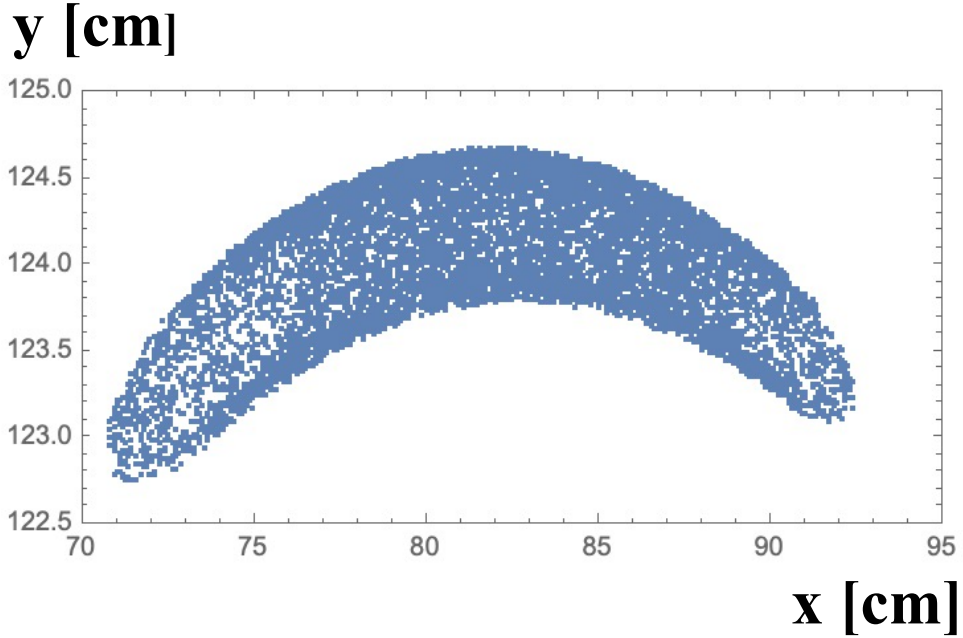


- **Step through the field, radiate Cherenkov photons when 100< r <125, reflect them from spherical mirror and find their intersection with a detector plane.**

Ring image at mirror for $\theta_{dip} = 86^o$

B = 5 Tesla,
P = 20 GeV/c pions
Pt = 19.951 GeV/c
Pz = 1.3973 GeV/c
Theta = 86°
Phi = 90°
R-helix=13.3 meters
θ_C = 0.0532 rad
Npe = 16
C_4F_{10} gas

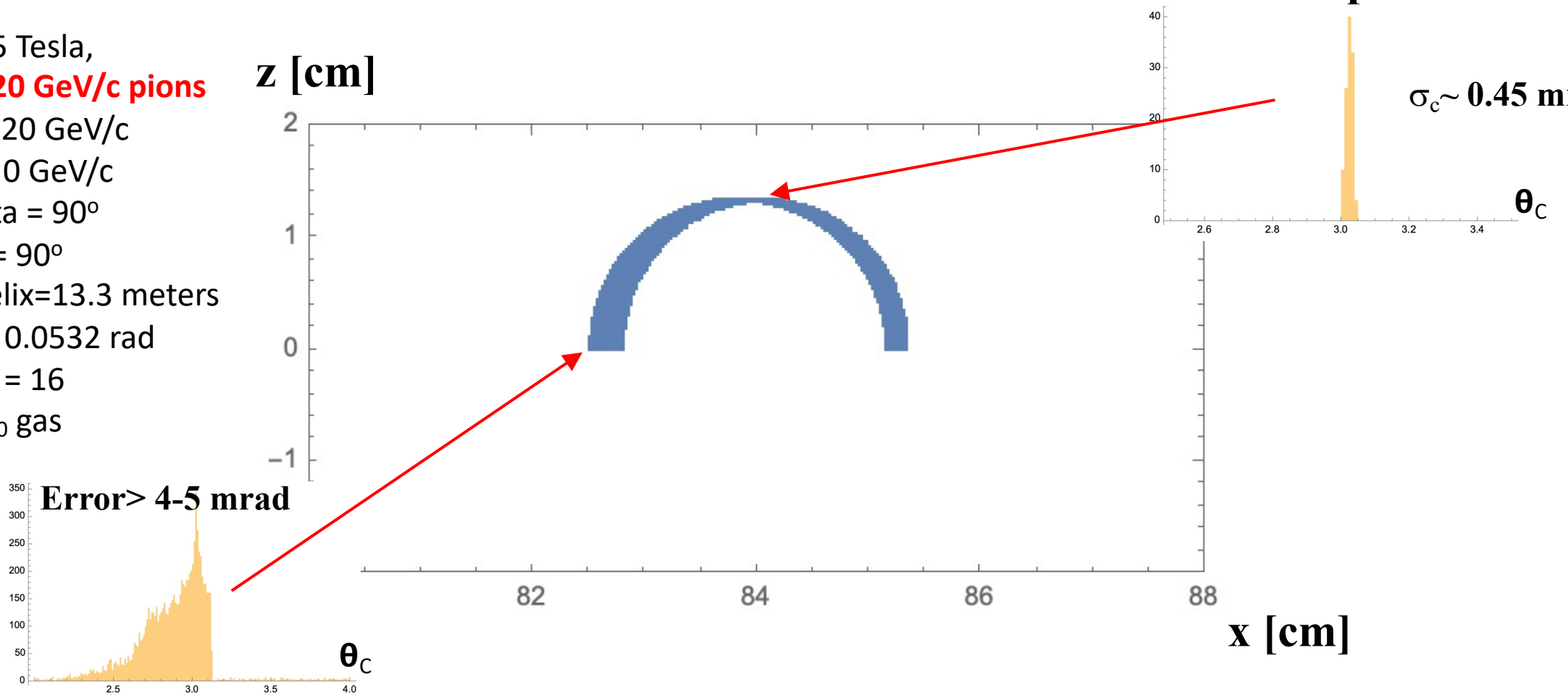




- **No useful image at the mirror photon intersection**

A clear ring image at SiPMT detector for $\theta_{dip} = 90^o$

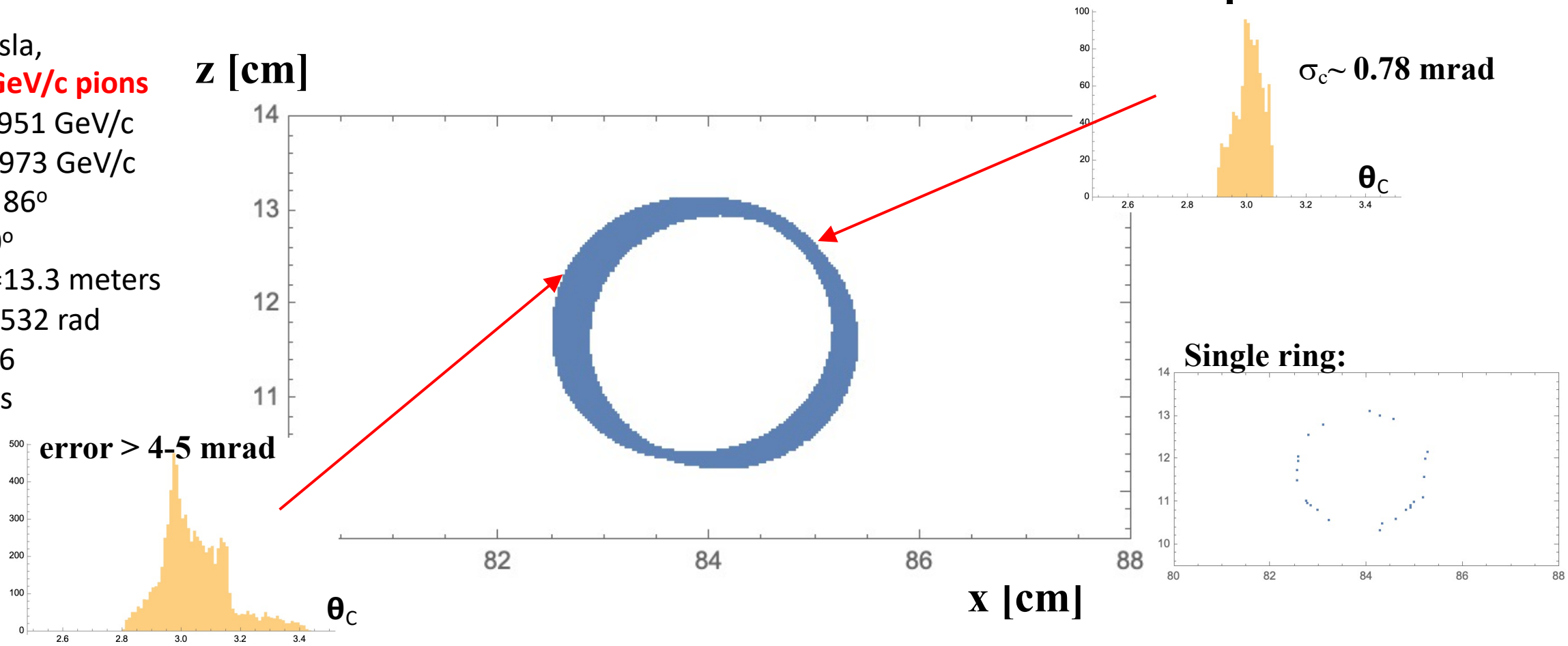
B = 5 Tesla,
P = 20 GeV/c pions
Pt = 20 GeV/c
Pz = 0 GeV/c
Theta = 90°
Phi = 90°
R-helix=13.3 meters
θ_C = 0.0532 rad
Npe = 16
C_4F_{10} gas



- **There is a variation of resolution around azimuth of the ring (angle Φ_c)**

A clear ring image at SiPMT detector for $\theta_{dip} = 86^o$

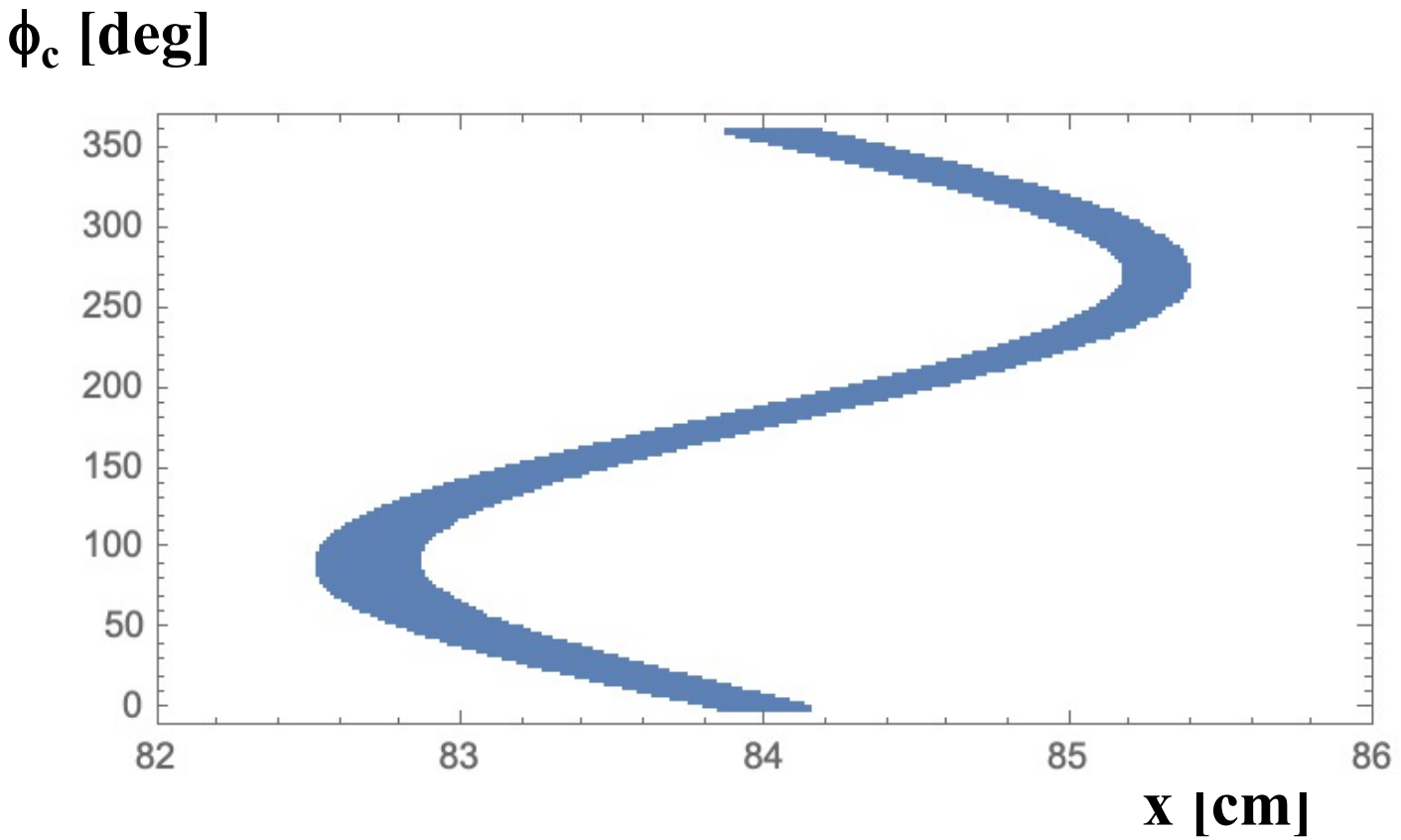
B = 5 Tesla,
P = 20 GeV/c pions
Pt = 19.951 GeV/c
Pz = 1.3973 GeV/c
Theta = 86°
Phi = 90°
R-helix=13.3 meters
θ_C = 0.0532 rad
Npe = 16
C_4F_{10} gas

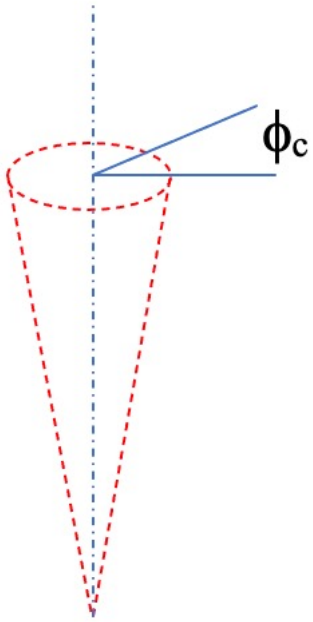


- **Best & worst resolution rotates around azimuth of the ring (angle ϕ_c)**

Ring image at SiPMT detector for $\theta_{dip} = 86^o$

B = 5 Tesla,
P = 20 GeV/c pions
Pt = 19.951 GeV/c
Pz = 1.3973 GeV/c
Theta = 86°
Phi = 90°
R-helix=13.3 meters
θ_C = 0.0532 rad
Npe = 16
C_4F_{10} gas

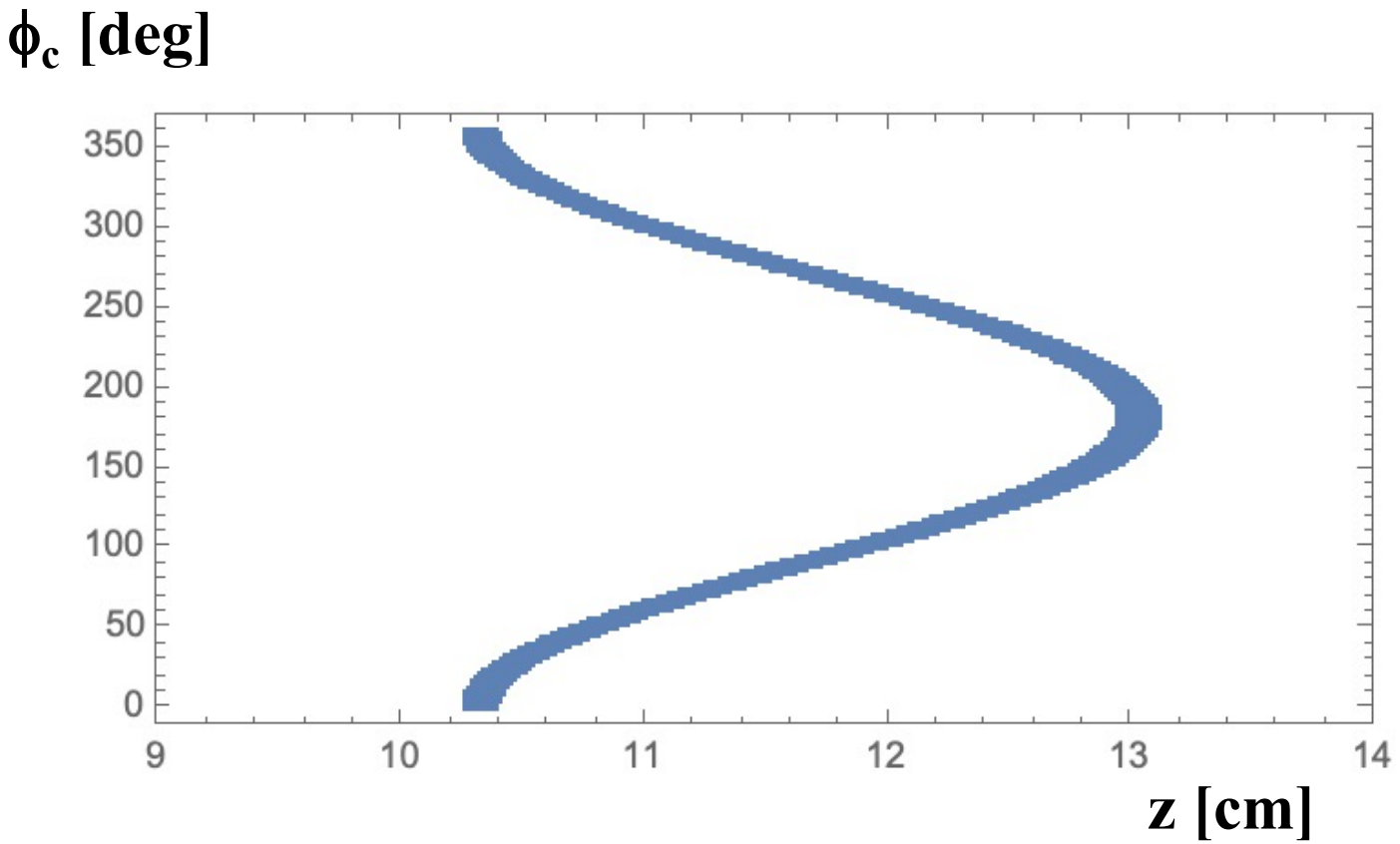


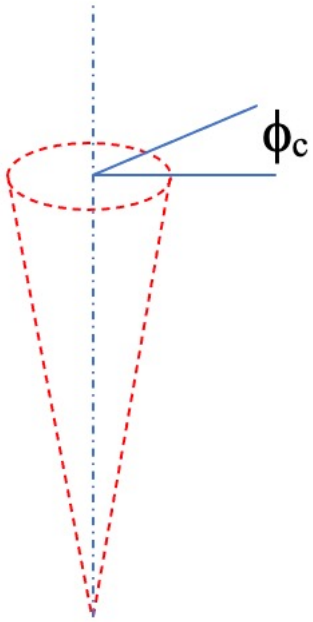


- **Resolution varies as a function of ϕ_c.**

Ring image at SiPMT detector for $\theta_{dip} = 86^o$

B = 5 Tesla,
P = 20 GeV/c pions
Pt = 19.951 GeV/c
Pz = 1.3973 GeV/c
Theta = 86°
Phi = 90°
R-helix=13.3 meters
θ_C = 0.0532 rad
Npe = 16
C_4F_{10} gas

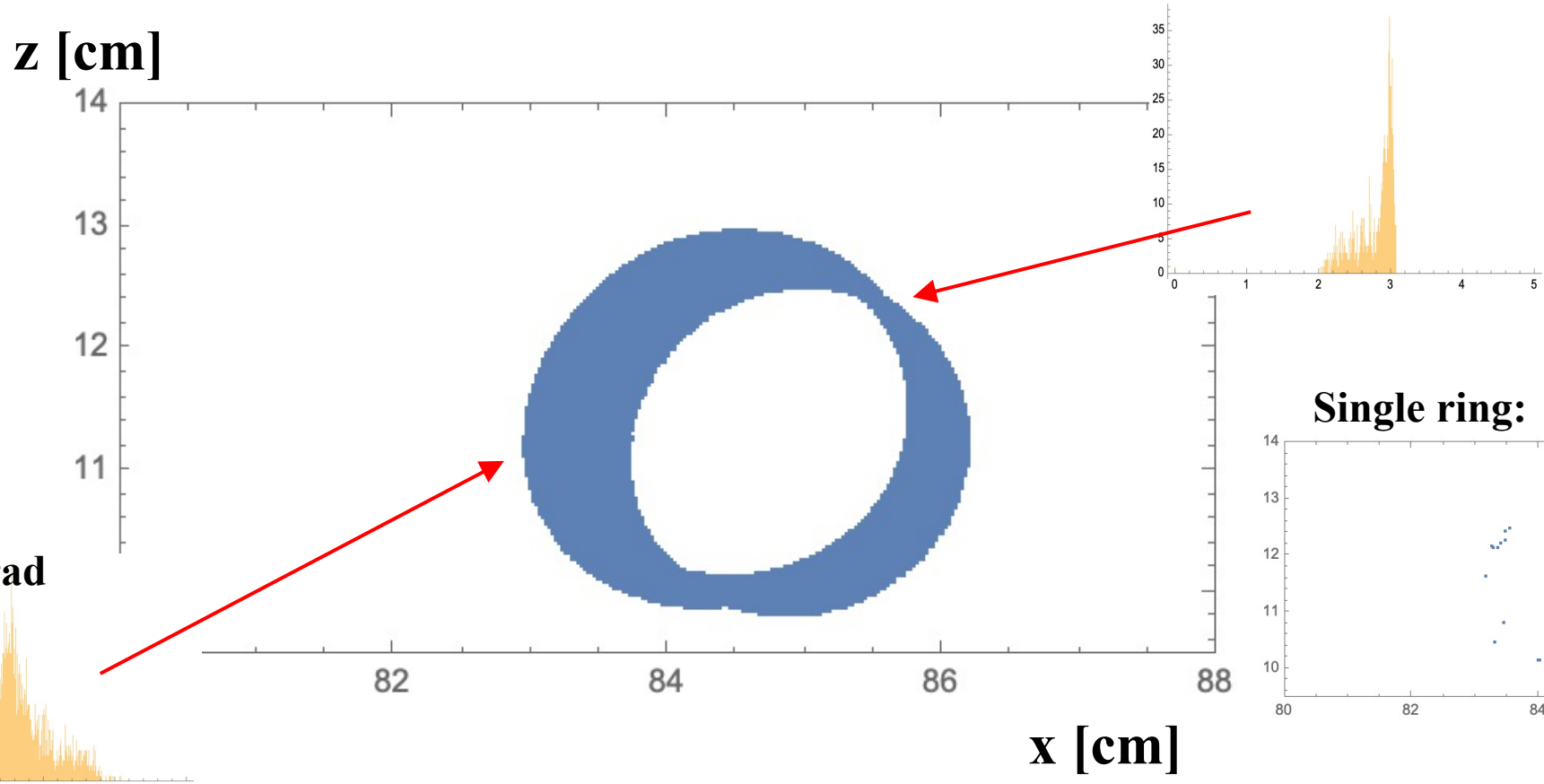




- **Resolution varies less in z-direction as a function of ϕ_c.**

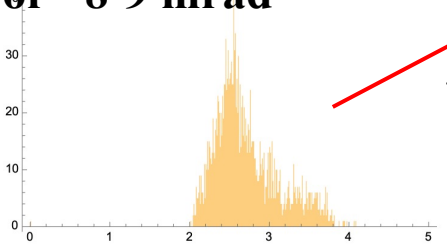
A clear ring image at SiPMT detector for $\theta_{dip} = 86^o$

B = 5 Tesla,
P = 10 GeV/c pions
Pt = 9.975 GeV/c
Pz = 0.698 GeV/c
Theta = 86°
Phi = 90°
R-helix= 6.65 meters
θ_C = 0.0532 rad
Npe = 16
C_4F_{10} gas



Single ring:

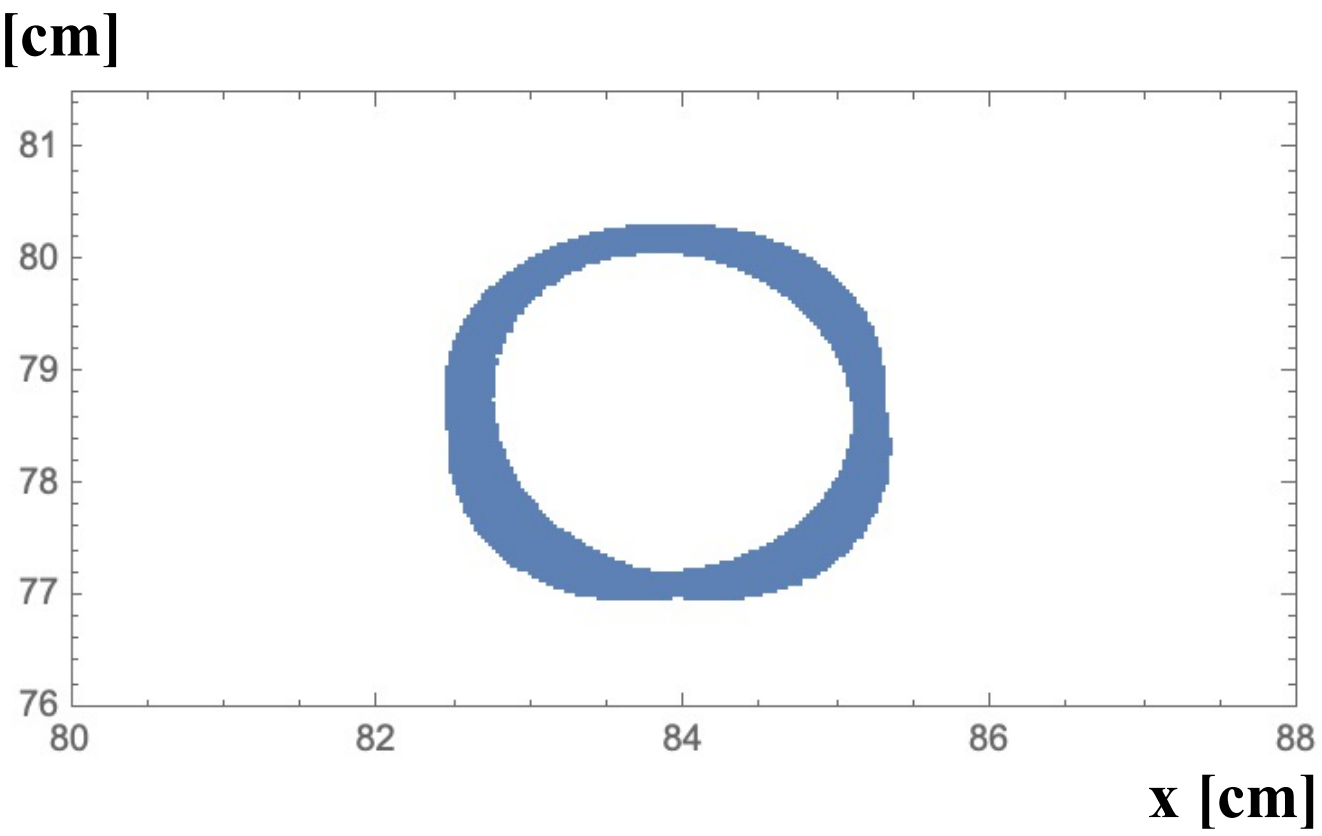
error~ 8-9 mrad



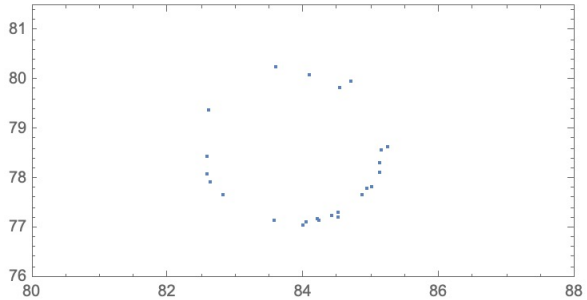
- **Lower the momentum, shift in ring position is more significant.**

A clear ring image at SiPMT detector for $\theta_{dip} = 70^o$

B = 5 Tesla,
P = 20 GeV/c pions
Pt = 18.793GeV/c
Pz = 6.842 GeV/c
Theta = 70°
Phi = 90°
R-helix=12.53 meters
θ_C = 0.0532 rad
Npe = 17.3
C_4F_{10} gas



Single ring:



- **Cherenkov cone rotates in 3D. Detector observes shift in image.**