

A gas-DIRC «gDIRC»
detector for gluex

Baptiste GUEGAN



Introduction

Using both DIRC and threshold Cherenkov detectors to cover the whole momentum range up to 8.5 GeV

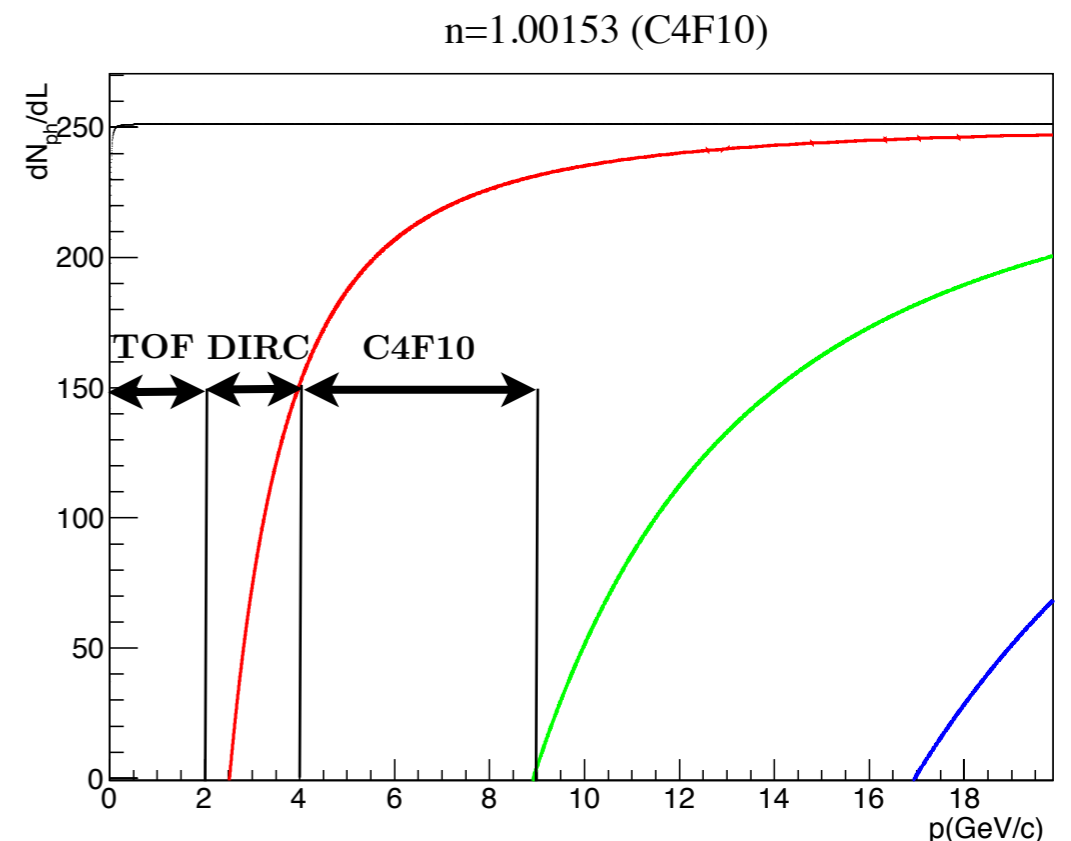
DIRC bars from BaBar experiment:

→ covering from $\sim 2\text{GeV}$ (TOF) to $\sim 4\text{GeV}$ (3σ separation for π/K)

Regular threshold Cherenkov C4F10:

→ covering from $\sim 4\text{GeV}$ to $\sim 8\text{GeV}$

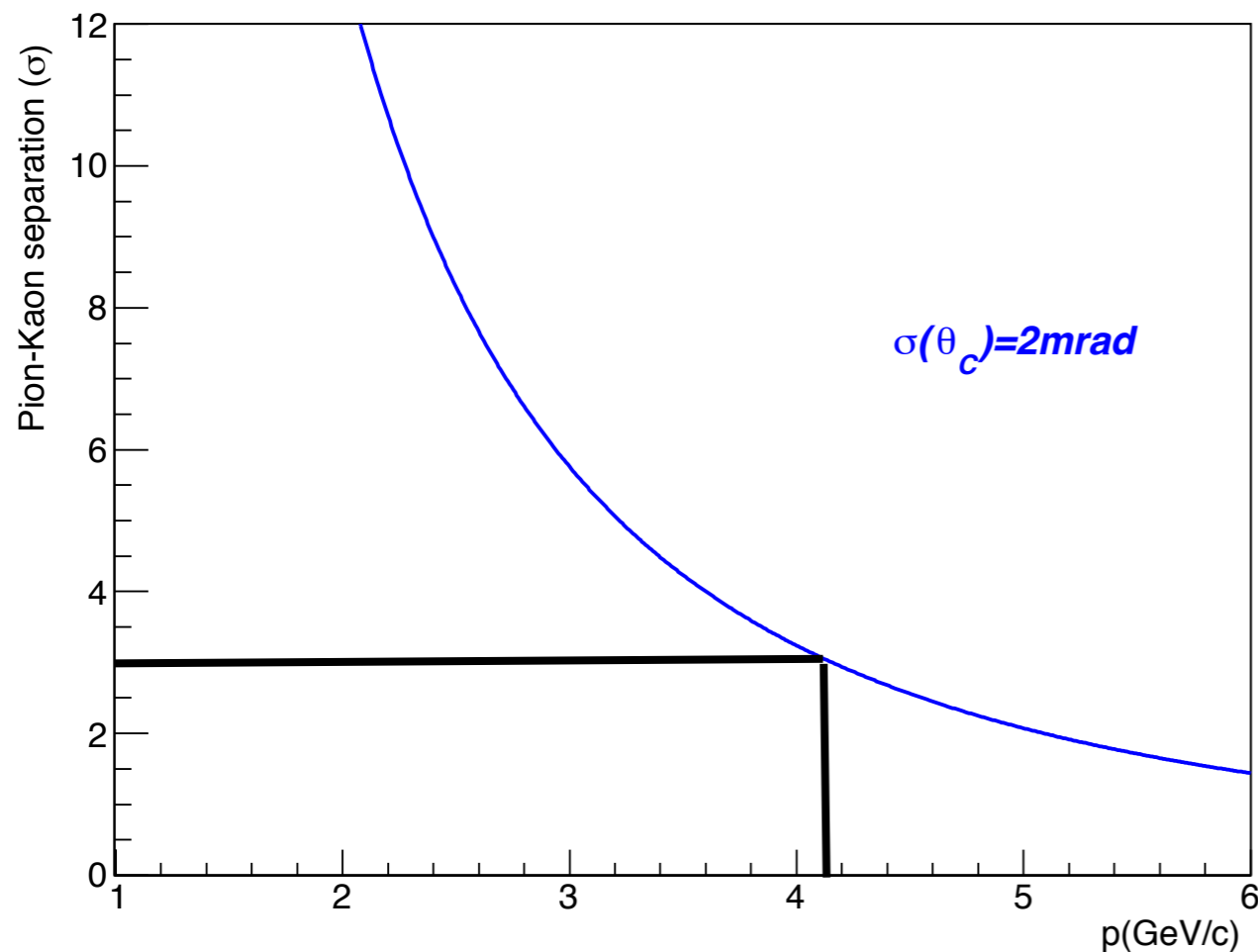
Using the same read-out for both systems



(Efficiencies not taken into account)

Specifications and requirements

For a 3σ separation up to $\sim 4\text{GeV}$, one need the Cherenkov angle resolution to be $\sim 2\text{mrad}$



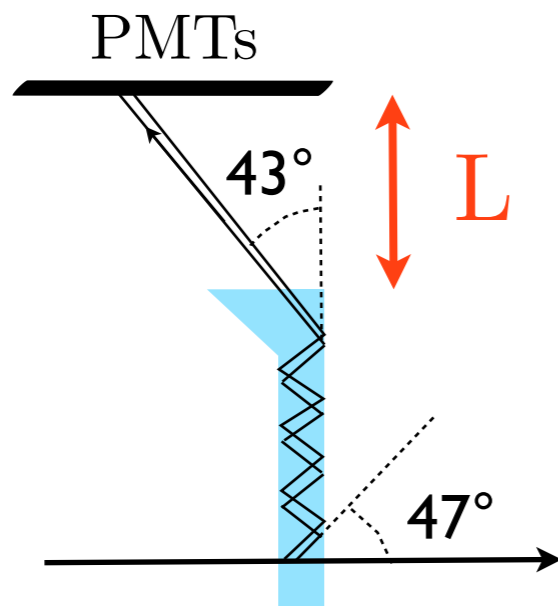
$$N_\sigma \approx \frac{|m_{kaon}^2 - m_{pion}^2|}{2p^2 \sigma[\theta_C(tot)] \sqrt{n^2 - 1}}$$

$$\sigma_{\theta_\gamma} = \sigma_{\theta_C} \times \sqrt{N_\gamma} \quad \text{With: } N_\gamma \approx 25$$

$$\longrightarrow \sigma_{\theta_\gamma} = 10 \text{ mrad}$$

Specifications and requirements

Without FOCUSING:



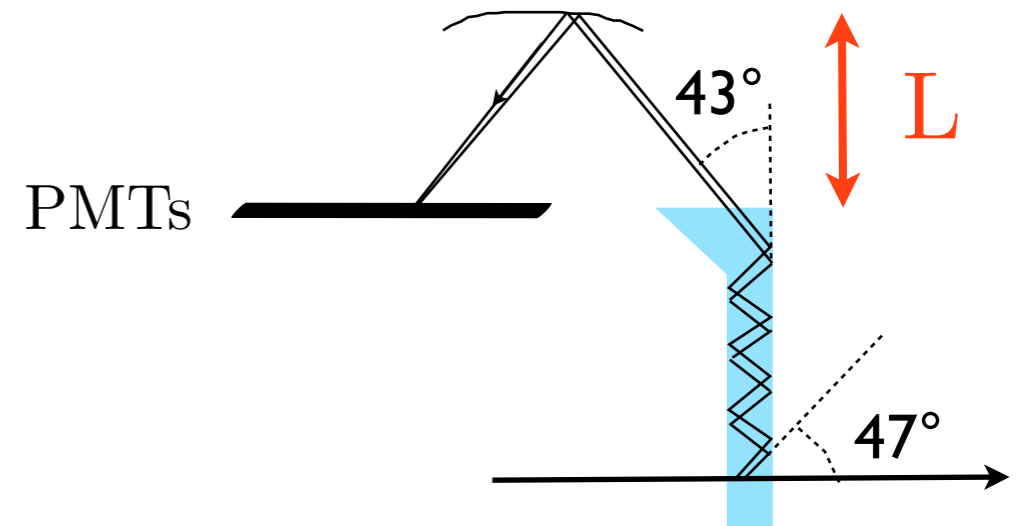
$$\sigma_{\theta_\gamma} = \sqrt{\sigma_{\theta_I}^2 + \sigma_{\theta_D}^2 + \sigma_{\theta_{chrom}}^2 + \sigma_{\theta_{trans}}^2}$$

$$\sigma_{\theta_\gamma} = \sqrt{\frac{\sigma_{bar}^2}{L^2} + \frac{\sigma_{pixel}^2}{L^2} + 5.4^2 mrad + 1^2 mrad}$$

→ L=620mm (For a 5x5mm pixel)

→ PMTs width area ~620mm

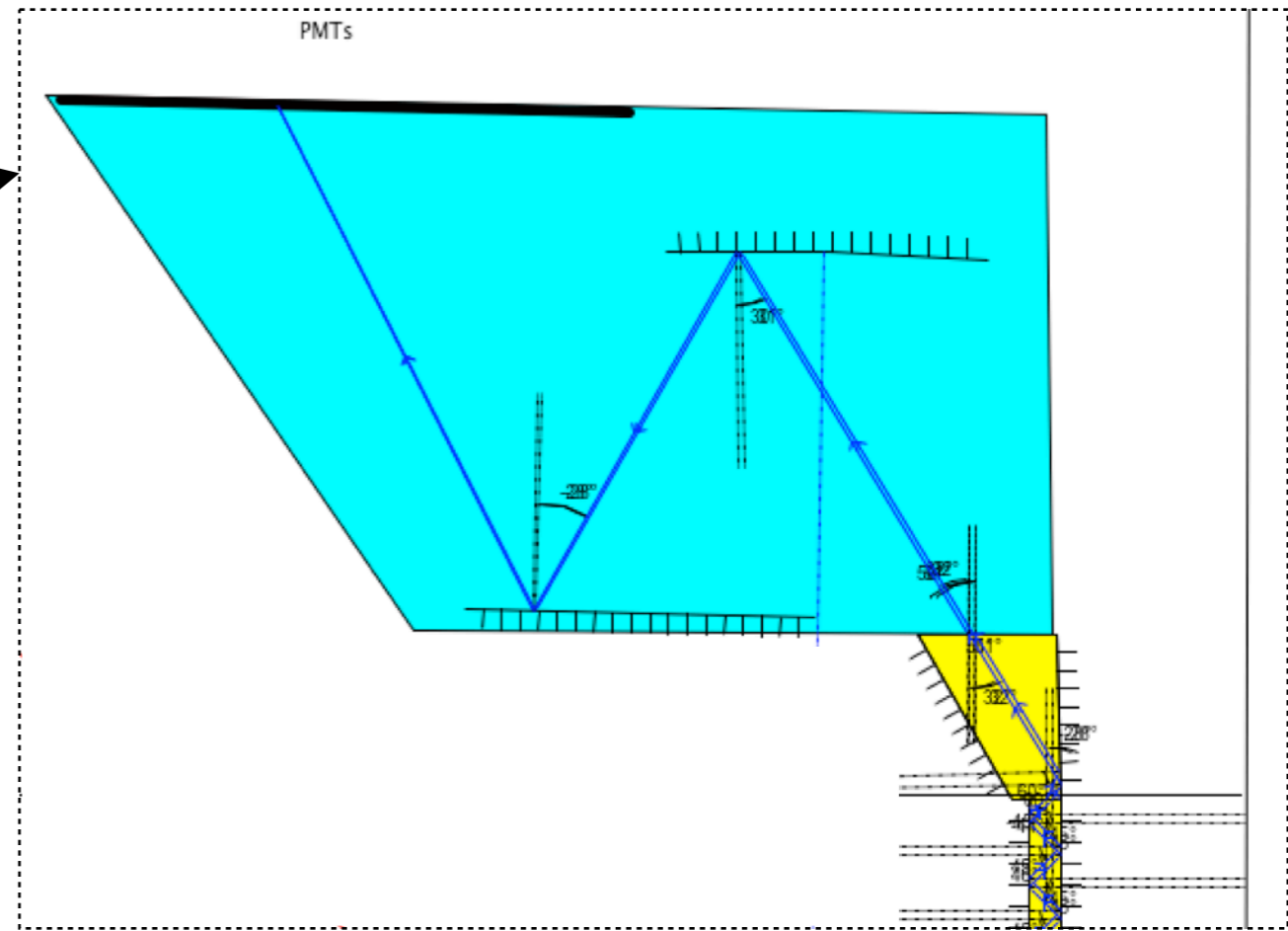
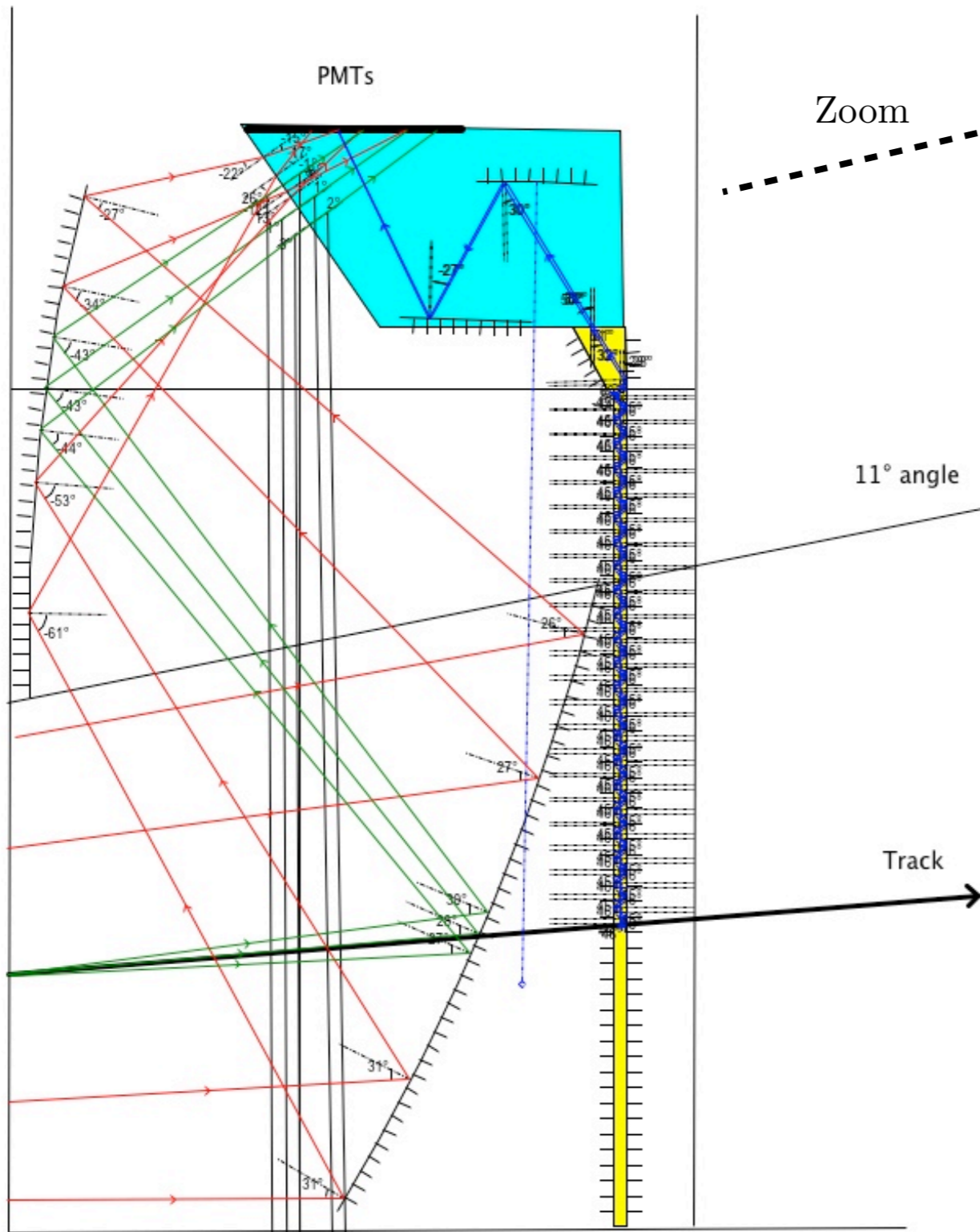
With FOCUSING:



$$\sigma_{\theta_\gamma} = \sqrt{\cancel{\sigma_{\theta_I}^2} + \sigma_{\theta_D}^2 + \sigma_{\theta_{chrom}}^2 + \sigma_{\theta_{trans}}^2}$$

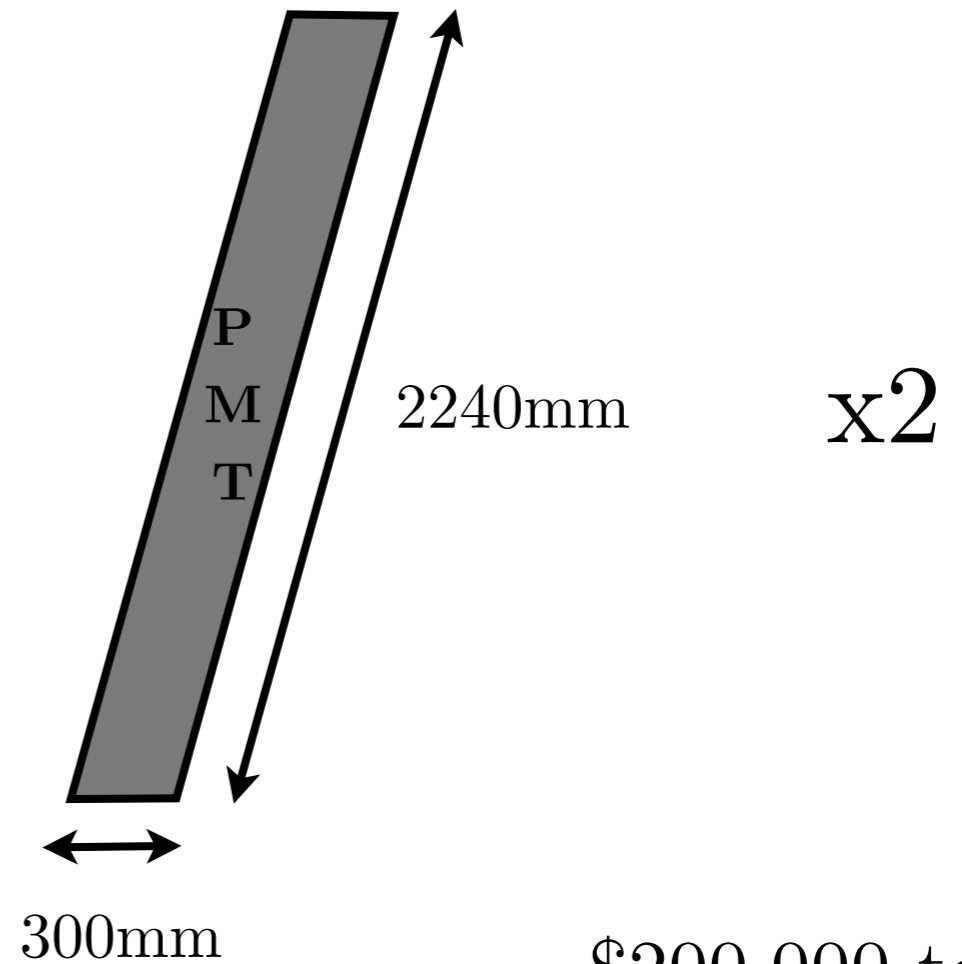
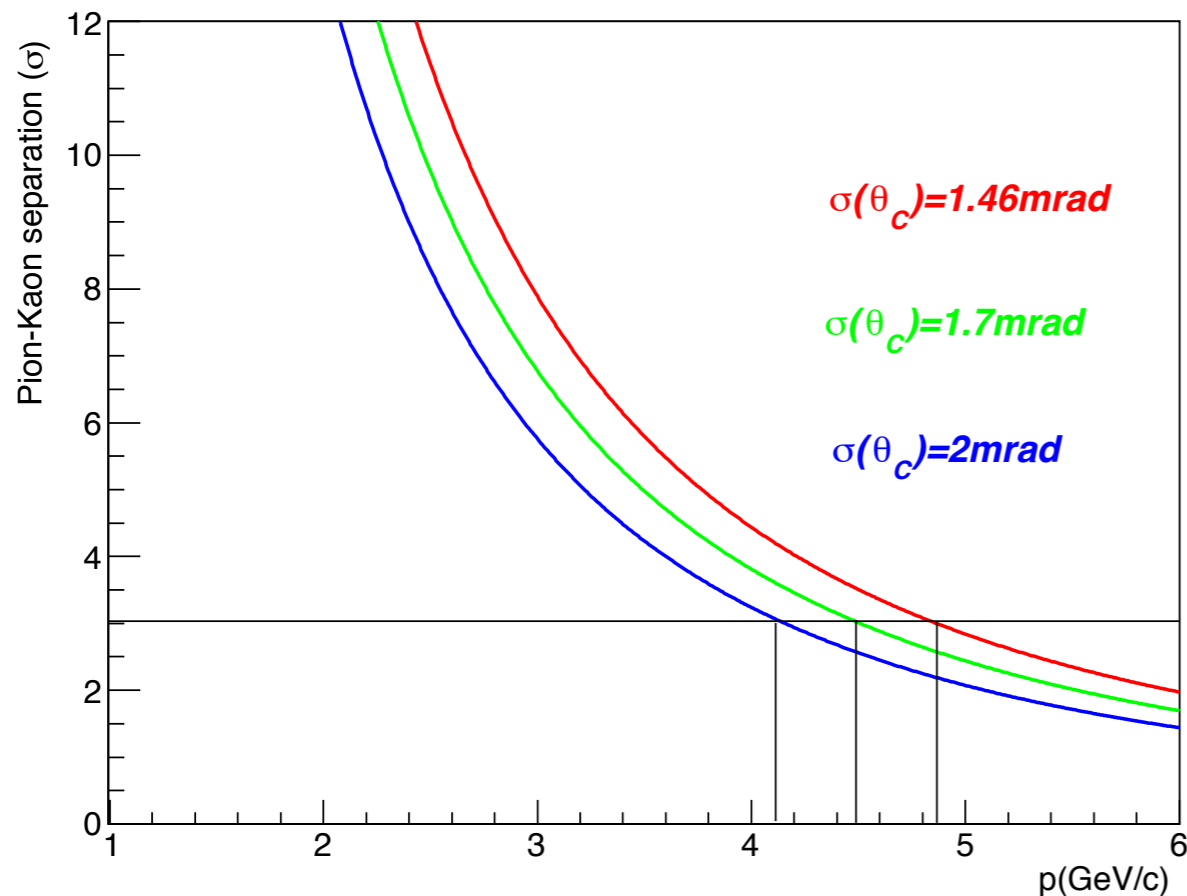
→ L=172mm

→ PMTs width area ~160mm



If $L = 300\text{mm}$ with FOCUSING design:

$$\rightarrow \sigma_{\theta_\gamma} = 7.3 \text{ mrad} \rightarrow \sigma_{\theta_C} = 1.46 \text{ mrad} \rightarrow 3\sigma \text{ up to } \sim 4.7\text{GeV}$$



~ \$200.000 total
for MCP-PMTs

Expected cost

- _ Two times 30x224cm = \$201.600 (approximately 34 MCP-PMTs)
 - _ 34x80 = 2720 channels -> \$163.200 (\$60 per channel for front-end electronics + DAQ)
 - _ \$34.000 (HV/LV power and cables)
 - _ \$250.000 (the gas system, including tank, gas system and C4F10)
 - _ \$50.000 (DIRC assembly and the end box)
 - _ \$100.000 (mirrors for C4f10) 4m²
 - _ \$50.000 supporting structure
-
- = \$848.800

Saving money: A 17mm*35mm*1200mm bar costs about \$20k

-> 64 BaBar bars: 17mm*35mm*4900mm ~ \$5millions

Work in progress

Geant4 simulations:

