Momentum Resolution Study using Kick Plane Analysis

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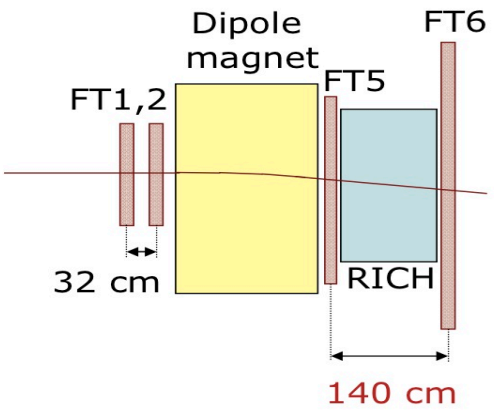
Outline

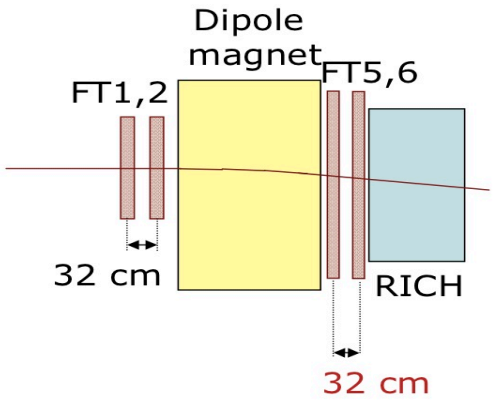
- Motivation
- Kick Plane Analysis
- $\Delta\theta_x$ Measurement
- $\Delta\theta_x$ vs P: Parameterization
- Momentum Reconstruction
- Momentum Resolution
- Summary

Motivation

- Momentum resolution of forward tracking spectrometer
- It contains six stations, each containing four double layers of straw tubes with wire orientation 0^o, -5^o, $+5^o$, 0^o
- In between 5^{th} and 6^{th} station Ring Imaging CHerenkov detector is placed for particle identification
- Low material budget required for high performance
- Compare momentum resolution for two setups,



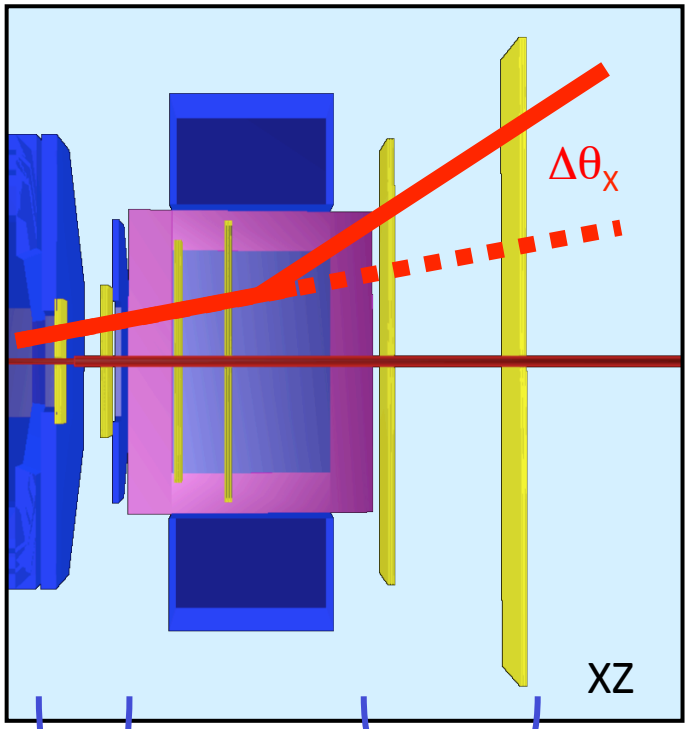
Standard Geometry



Compact Geometry

Kick Plane Analysis

Momentum reconstruction: 4 drift chambers



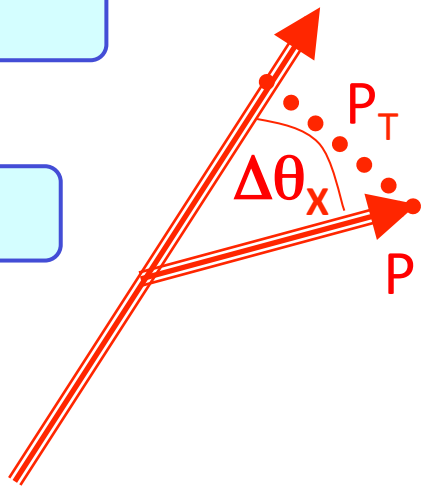
Inner segment

Outer segment

From deflection angle $\Delta\theta_X$

Kick parametrization P_T

$$\frac{P}{Z} = \frac{P_T}{2\sin\left(\frac{\Delta\theta_X}{2}\right)}$$



Momentum reconstruction

$$\frac{P}{Z} = \frac{A}{2\sin\left(\frac{\Delta\theta_X}{2}\right)} + B\cdot 2\sin\left(\frac{\Delta\theta_X}{2}\right) + C$$

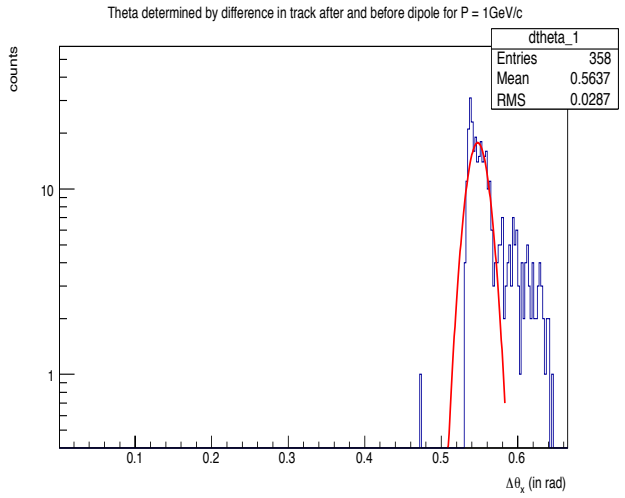
Taylor expansion

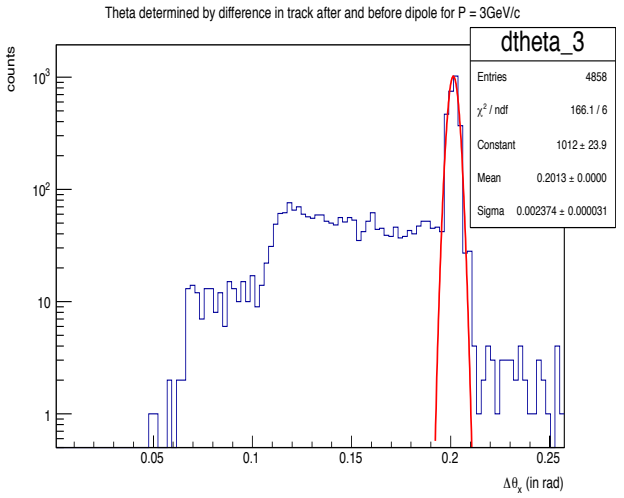
Parametrization of A B C

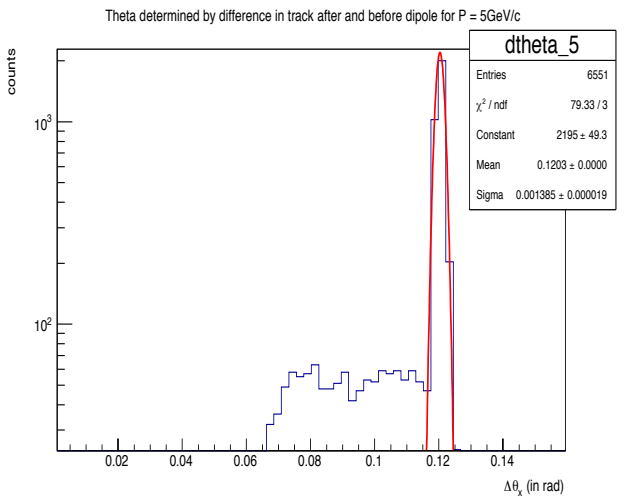
Kick Plane Analysis

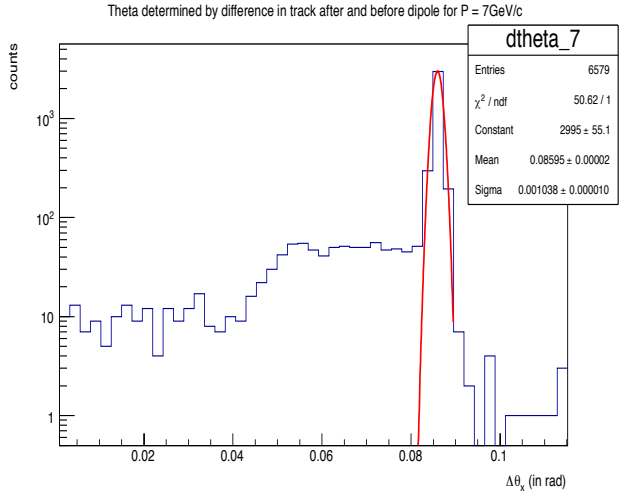
- Simulation Details :
  - BoxGenerator is used
  - 10,000 muons for momentum: 1 GeV, 2 GeV, … 15 GeV
  - Uniform phi: [0^o, 360^o]
  - Fixed theta: [3^o,3^o]
  - Primary tracks
  - Detectors included: FTS and RICH (included Beam Pipe & full Magnetic Field)
    - Simulation from fts macro used
  - Simulated for two set up
    - RICH in between FT5 & FT6
    - RICH after FT6
  - MC points used

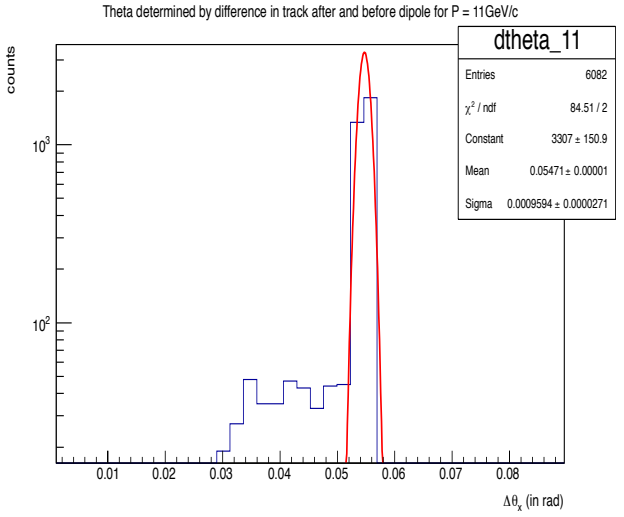
$\Delta\theta_x$: FT5-RICH-FT6

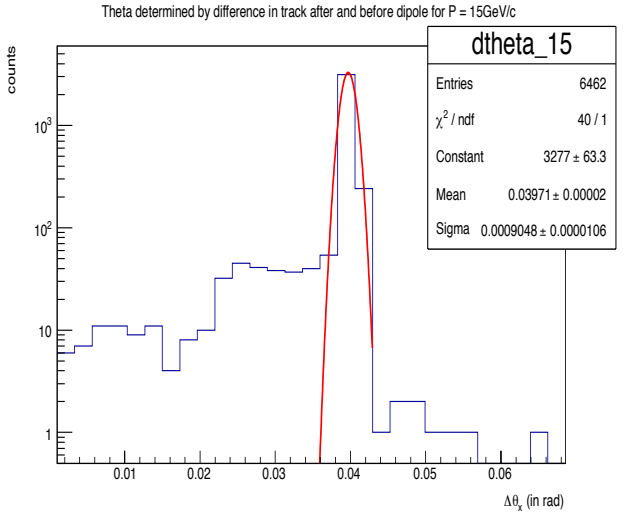




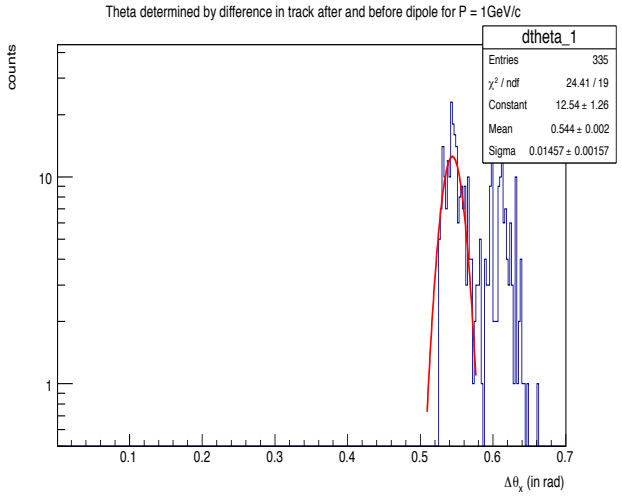


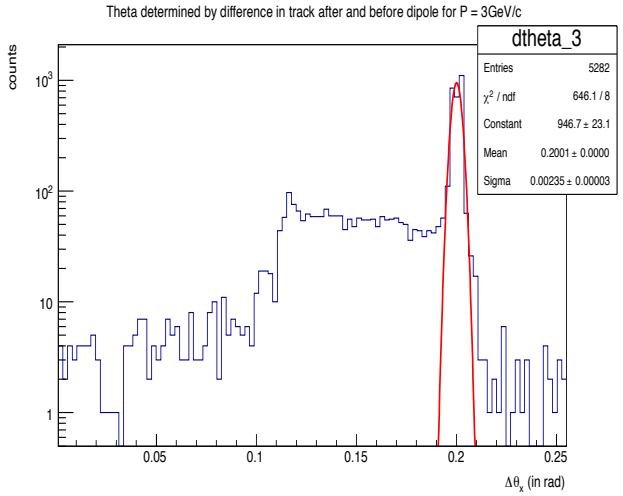


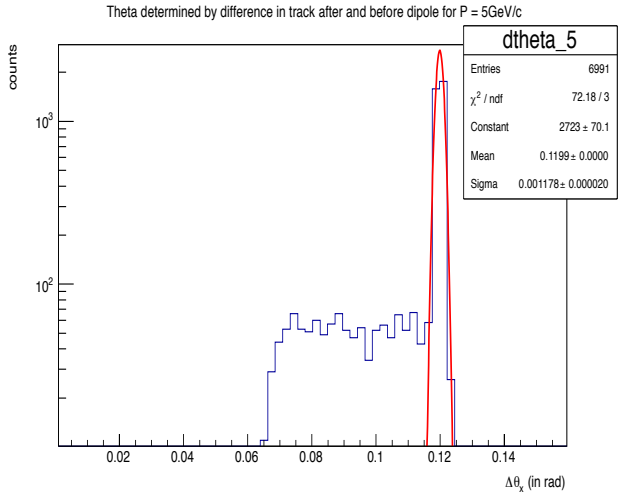


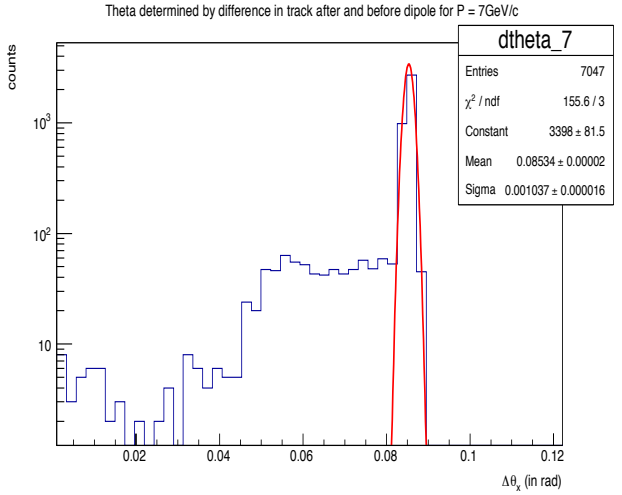


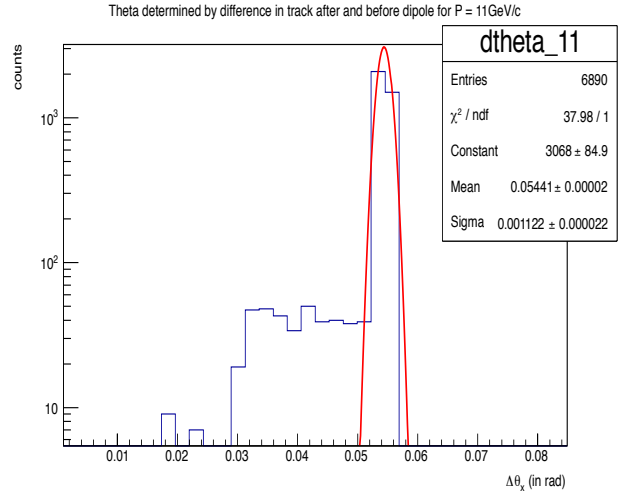
$\Delta\theta_x$: FT5-FT6-RICH

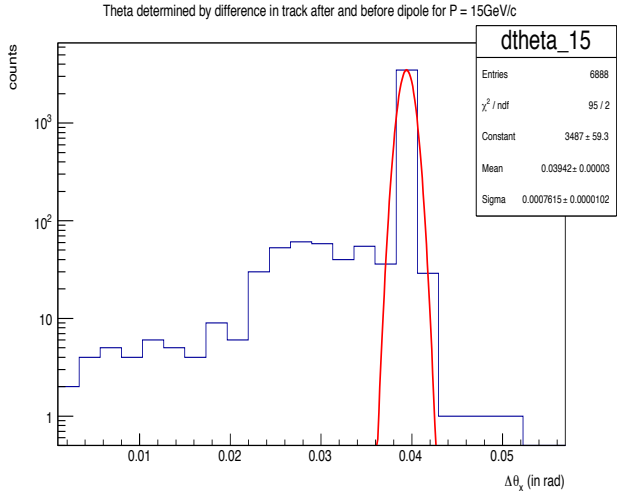




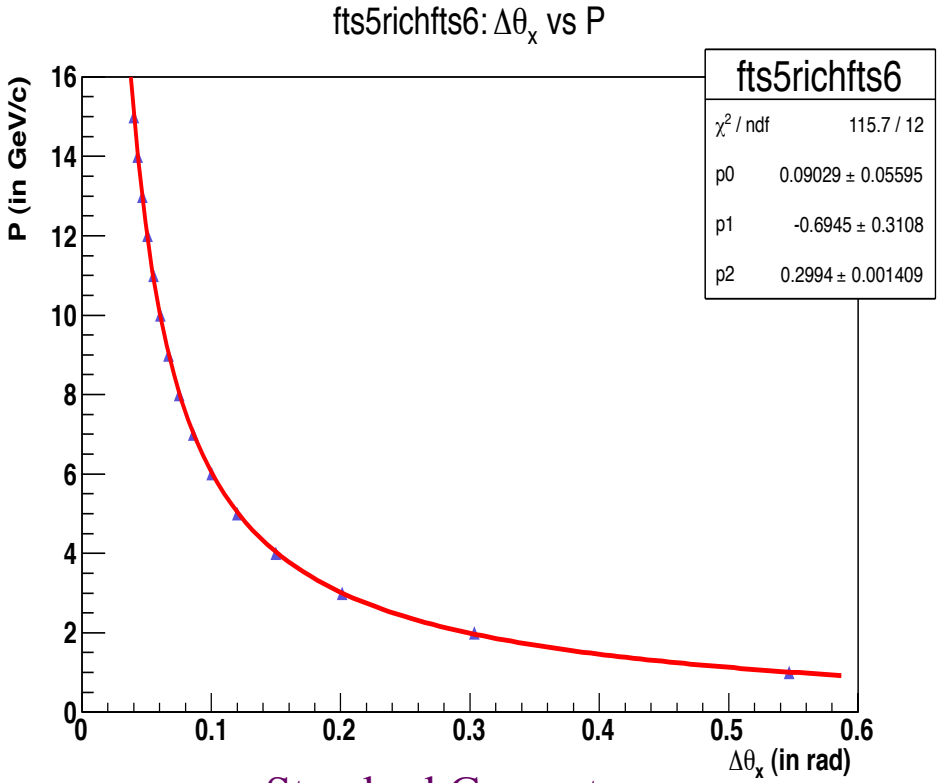




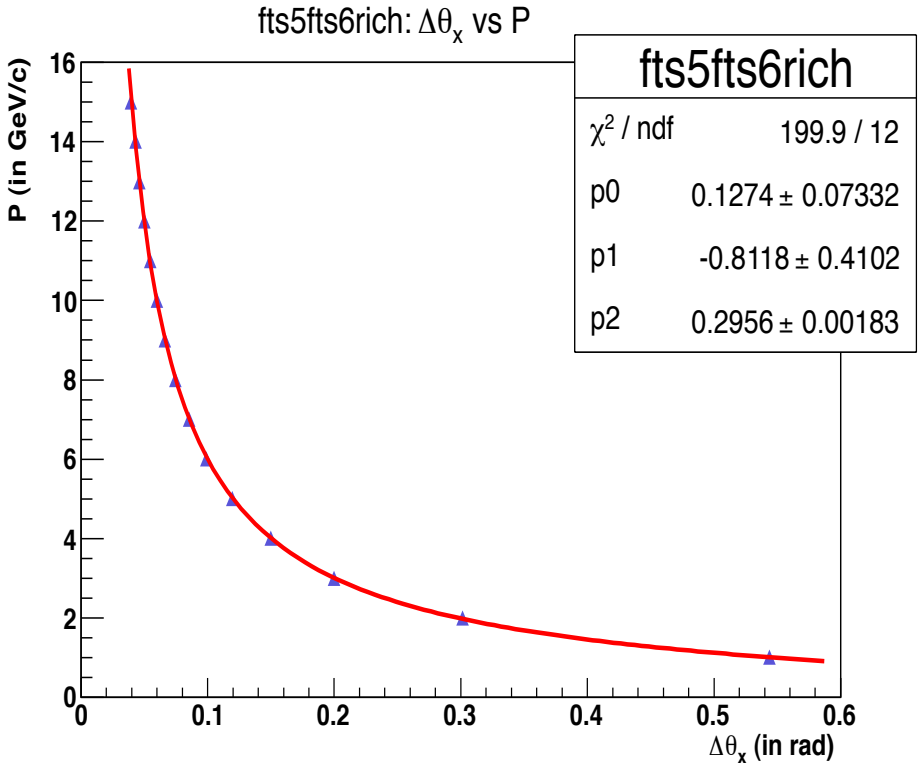




$\Delta\theta_x$ vs P : Parameterization



Standard Geometry



Compact Geometry

Fitting parameters:

FT5-RICH-FT6

A(p2): **0.2994 ± 0.001409**

B(p1): **-0.6945 ± 0.3108**

C(p0): **0.09029 ± 0.05595**

FT5-FT6-RICH

A(p2): **0.2956 ± 0.00183**

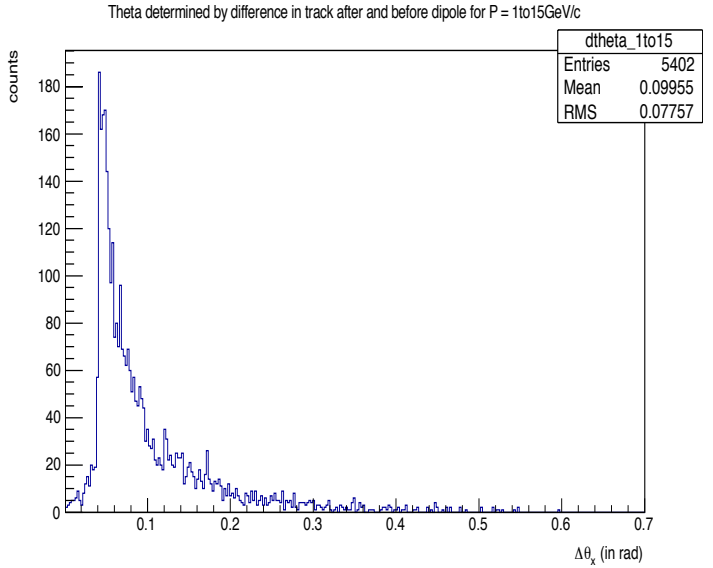
B(p1): **-0.8118 ± 0.4102**

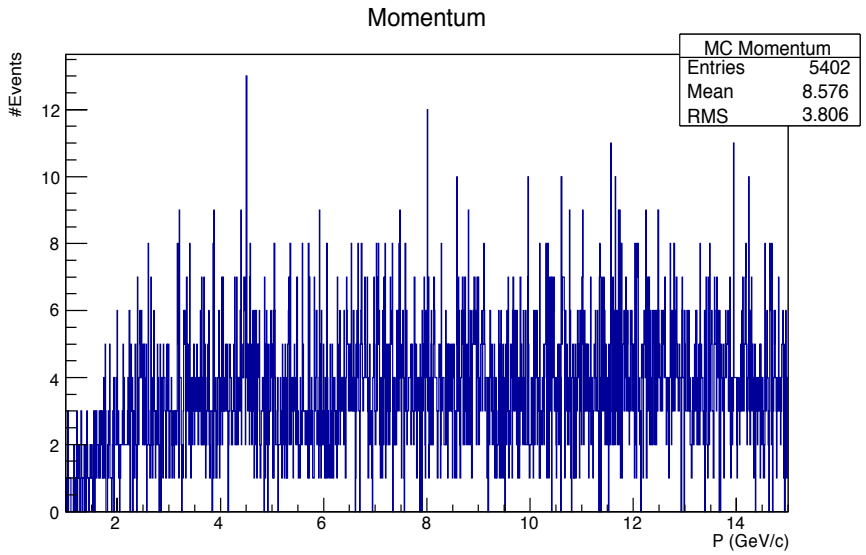
C(p0): **0.1274 ± 0.07332**

Momentum Reconstruction

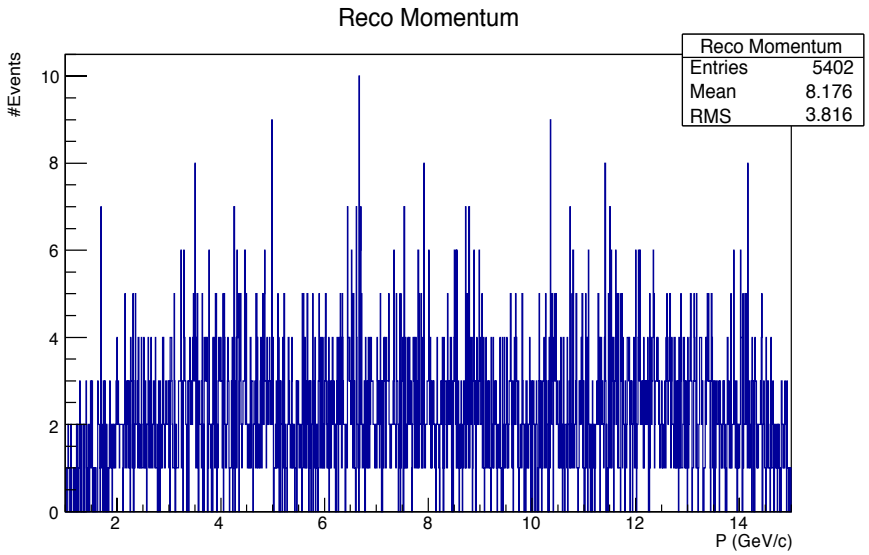
FTS5-RICH-FTS6

- BoxGenerator is used
- 10,000 muons for momentum: 1 to15 GeV
- Uniform phi: [0^o, 360^o]
- Fixed theta: [3^o,3^o]
- Primary tracks
- Detectors included: FTS and RICH
  - Simulation from fts macro used





MC Momentum

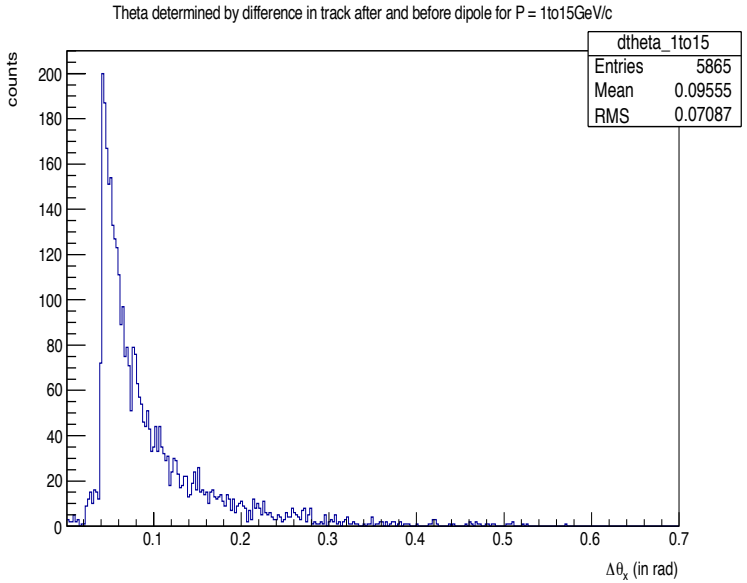


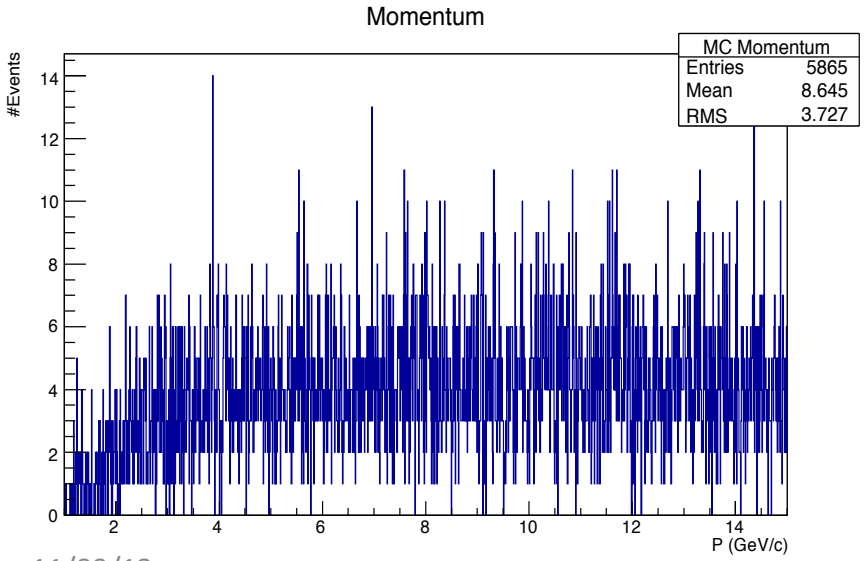
Reco Momentum

Momentum Reconstruction

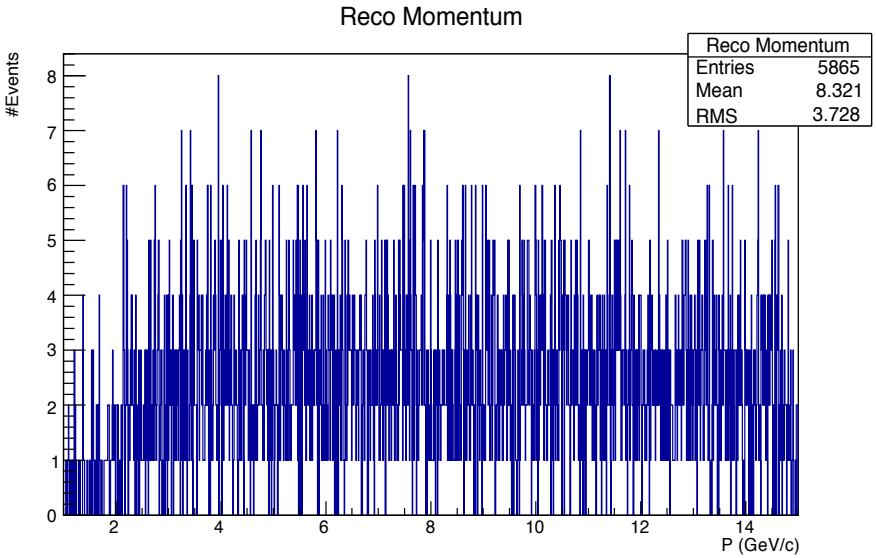
FTS5-FTS6-RICH

- BoxGenerator is used
- 10,000 muons for momentum: 1 to15 GeV
- Uniform phi: [0º, 360º]
- Fixed theta: [3º,3º]
- Primary tracks
- Detectors included: FTS and RICH
  - Simulation from fts macro used



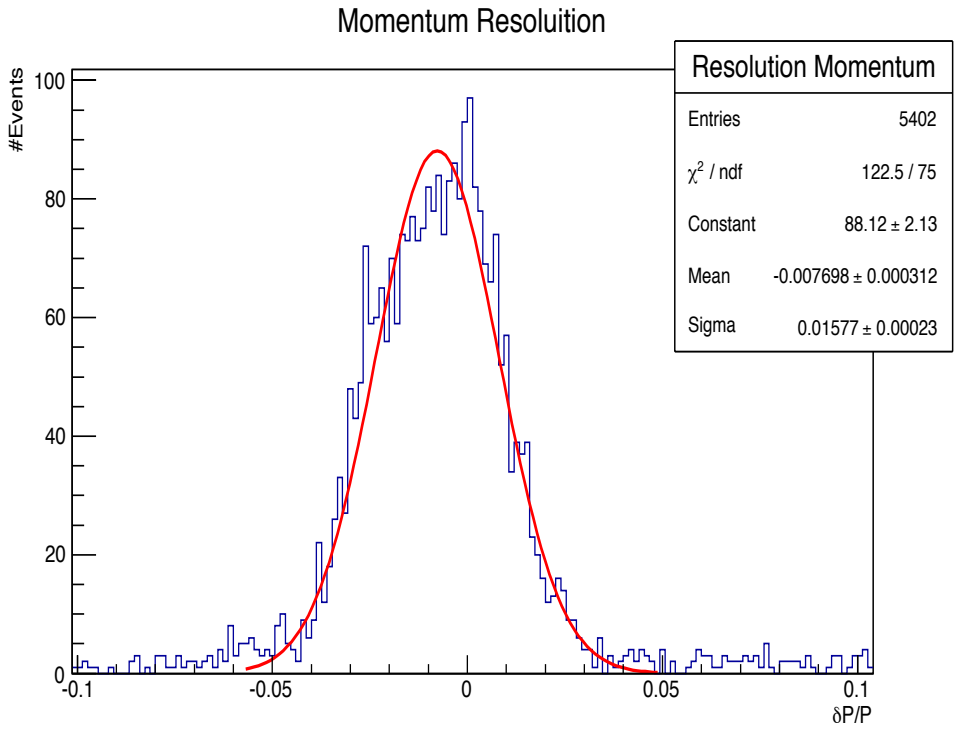


MC Momentum



Reco Momentum

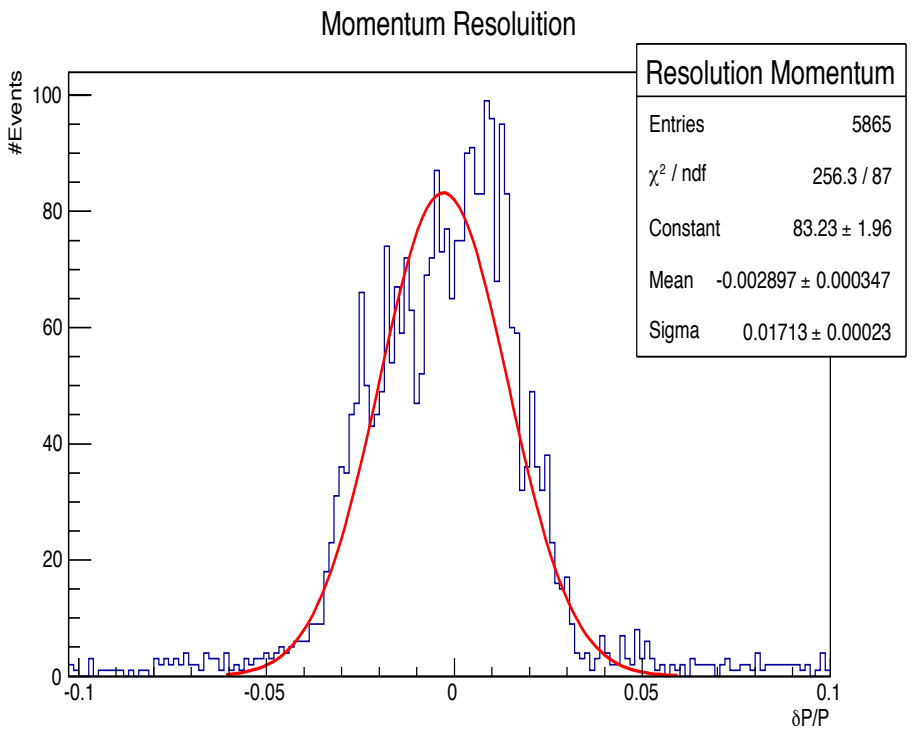
Momentum Resolution



Standard Geometry

FT5-RICH-FT6

Sigma: 1.577%



Compact Geometry

FT5-FT6-RICH

Sigma: 1.713%

Momentum Resolution calculated is average over range of momentum from 1 GeV/c to 15 GeV/c

Summary

- $\Delta\theta_x$ has been studied for momentum from 1 GeV to 15 GeV
- Momentum Resolutions compared for two setups of FTS using FTS and RICH detector.
- It seem to be approximately same resolution for two setups but with difference in efficiency.

Future Plan

- To use full PANDA detector to understand contribution from other detectors.
- Use Reco Hits for momentum resolution study.

Thank you