π^0 reconstruction

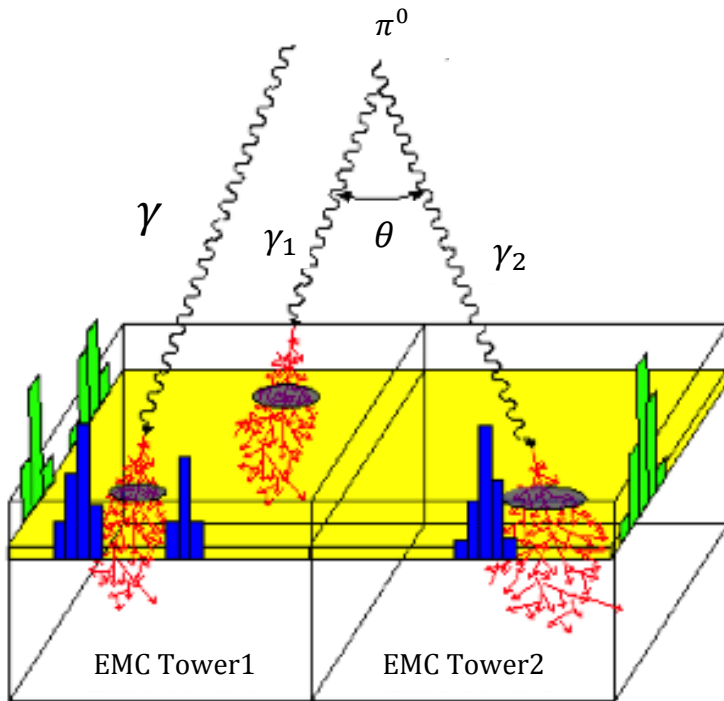27 Sep. 2013
Radio Astronomy Lab.
Kazuyoshi Kobayashi

Outline

1. Introduction

π^0 reconstruction

QGP <- direct photon generated by collision

$Pb + Pb\ collision$
$\rightarrow \pi^0 \rightarrow \gamma + \gamma$

$$m_{\pi^0} = \sqrt{2E_{\gamma_1}E_{\gamma_2}(1 - cos\theta)}$$

Detect gamma

↓

reconstruct the invariant mass of π^0

↓

Select only π^0

1. Introduction

Detector : EMCal

EMCal(ElectroMagnetic Calorimeter)
- measure high energy photon and electron
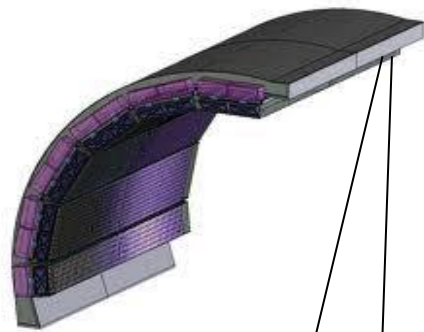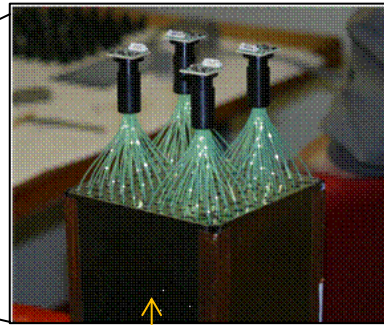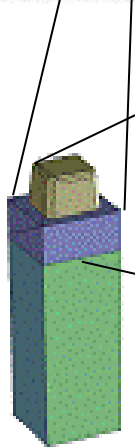- $-0.7 < \eta < 0.7 \ [rad] \ , \ 1.4 < \varphi < \pi \ [rad]$

Figure 2.1: The array of super modules shown in the installed position on their support structure.

Detect scintillator light
-> measure energy of photon
and electron

Electromagnetic shower

photon/electron

$$\eta = -\log\left(\tan\frac{\theta}{2}\right)$$

1. Introduction

Detector : TPC

http://utkhii.px.tsukuba.ac.jp/HU_Course/archive/20100702_0803_CERN_org/kubota_final.pdf
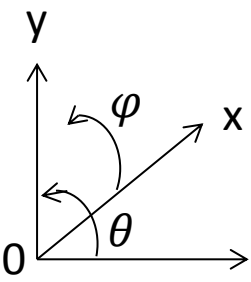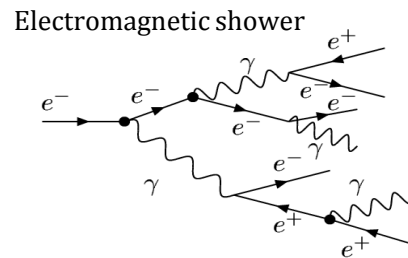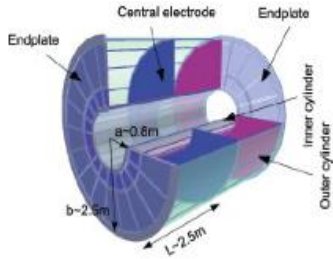
TPC(Time Projection Chamber)
· measure charged particles
· $-0.9 < \eta < 0.9 \, [rad] \, , \, 0 < \varphi < 2\pi \, [rad]$

y

z beam

x

filled gas

cathode

Ionized electron

charged particle

drift

anode

electric field
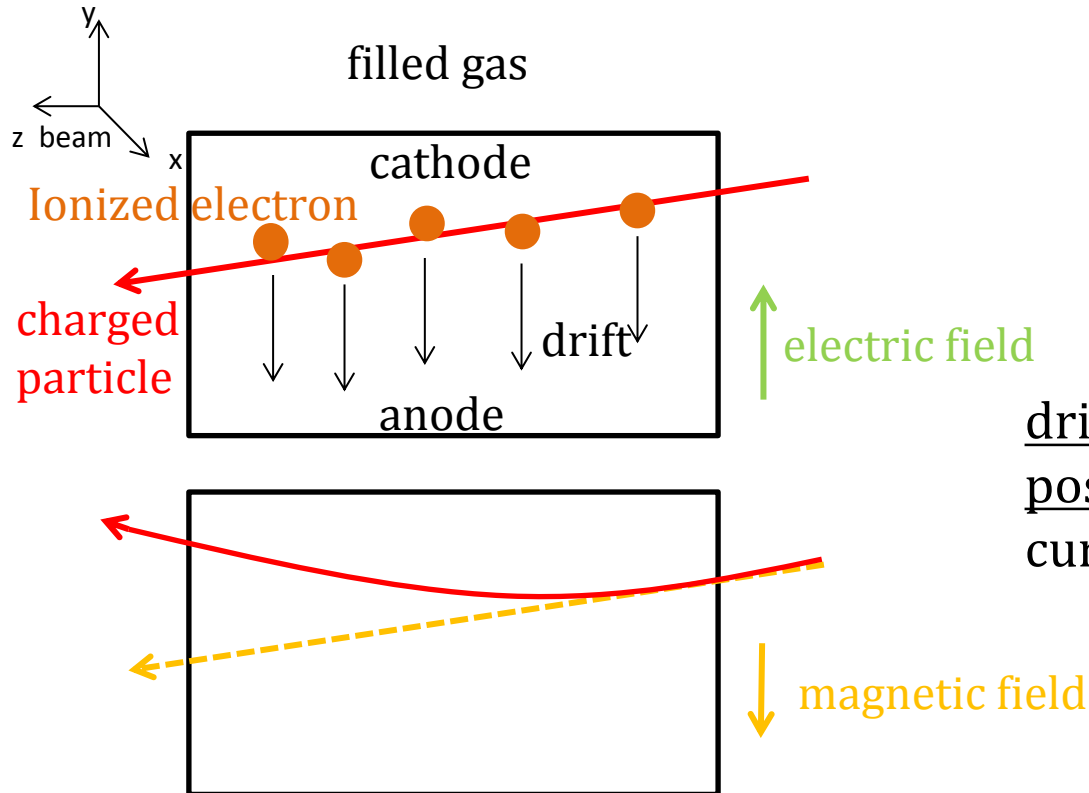
drift time of electron -> parameter y
positron -> parameter x,z
curvature -> momentum
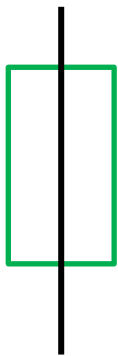
magnetic field

2. Analysis
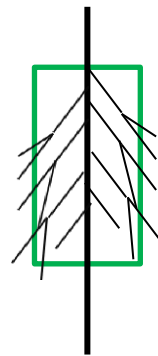
Condition of selection

1. MIP cut

- $E \geq 0.5$ GeV

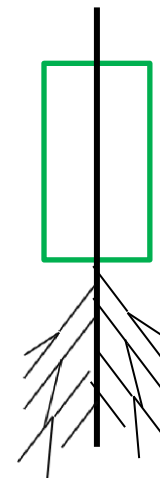- the number of Cells ≥ 2

| MIP(Minimum Ionizing Particle) |

MIP   electromagnetic shower   hadron shower
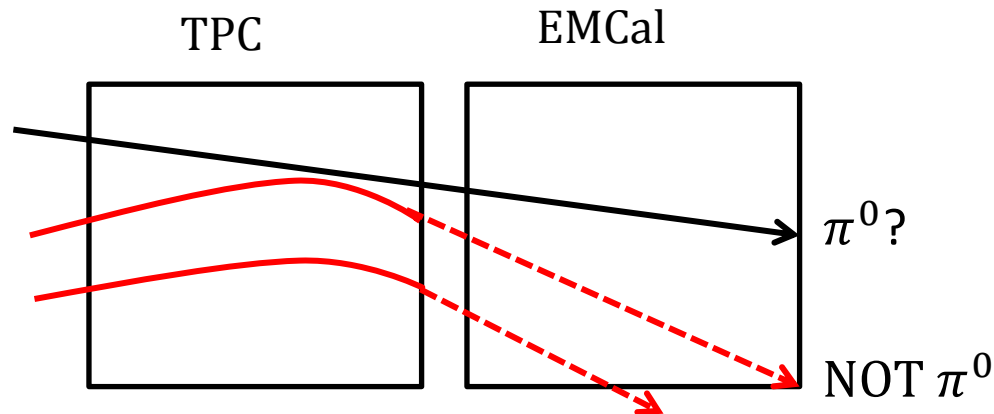
2. Analysis

Condition of selection

2. Track matching

extrapolate a track of electron to EMCal from that in TPC

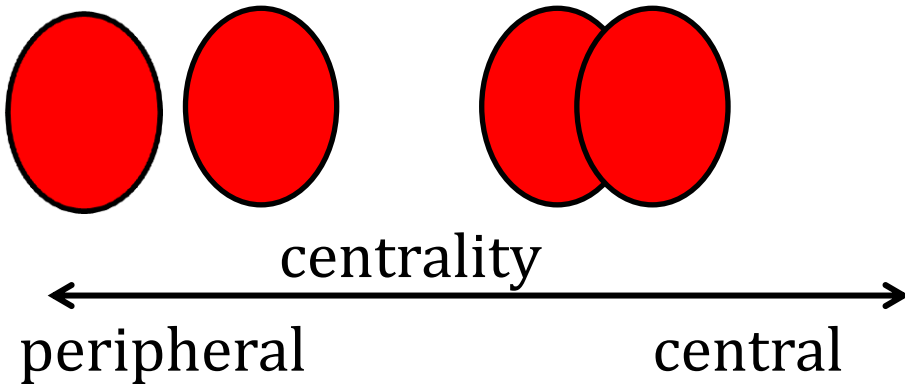if a track match to a cluster ➡ the cluster is <u>not π^0</u>

TPC   EMCal
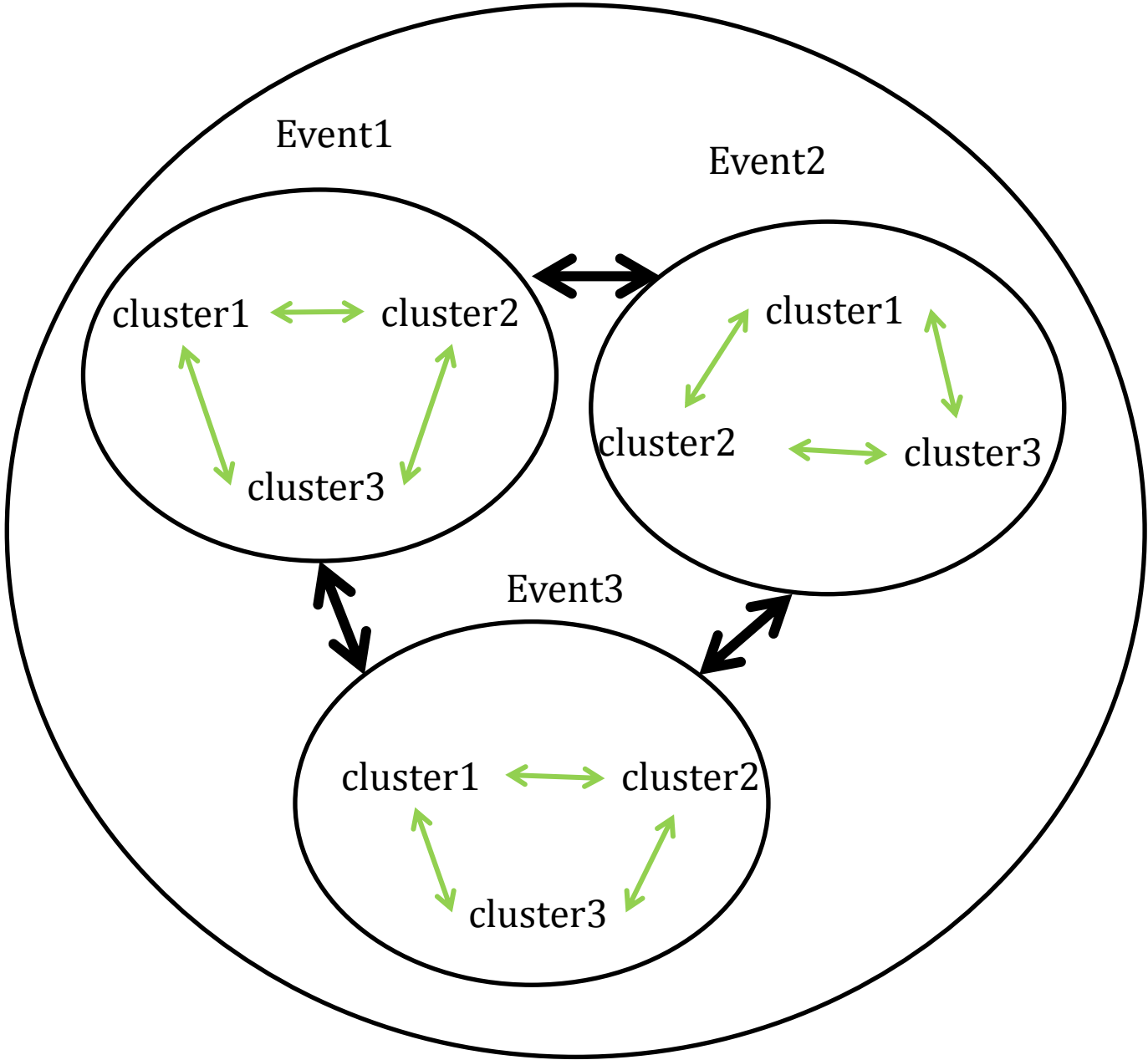
π^0?

NOT π^0

➡ track match = 0

2. Analysis

Event Mixing

Eventclass : <u>centrality</u> 10 × <u>vertex position(z)</u> 10 = 100 levels

centrality

peripheral   central

example

Eventclass1

Event1

Event2

Event3

cluster1 ↔ cluster2

cluster3
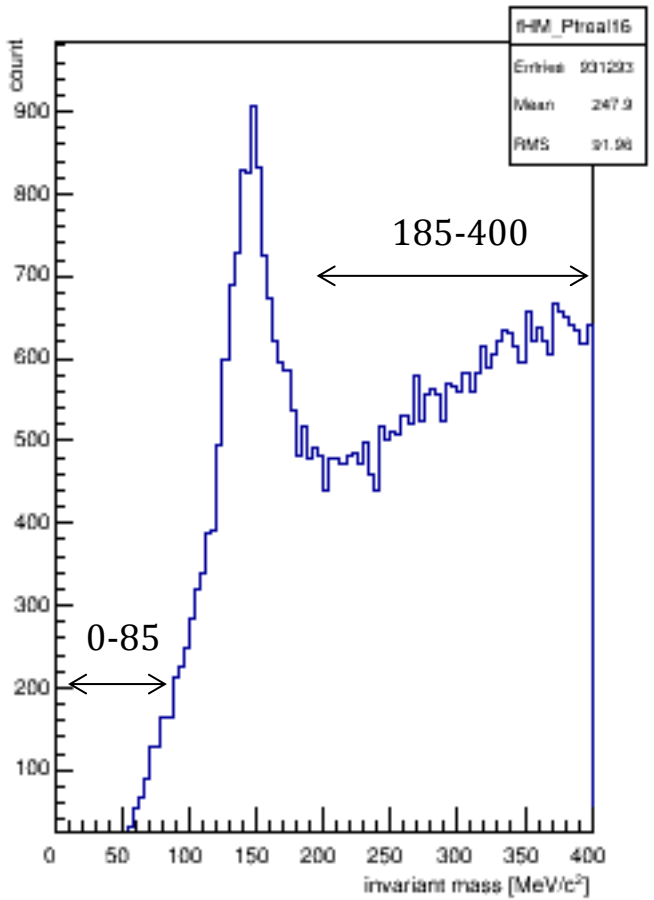
cluster1

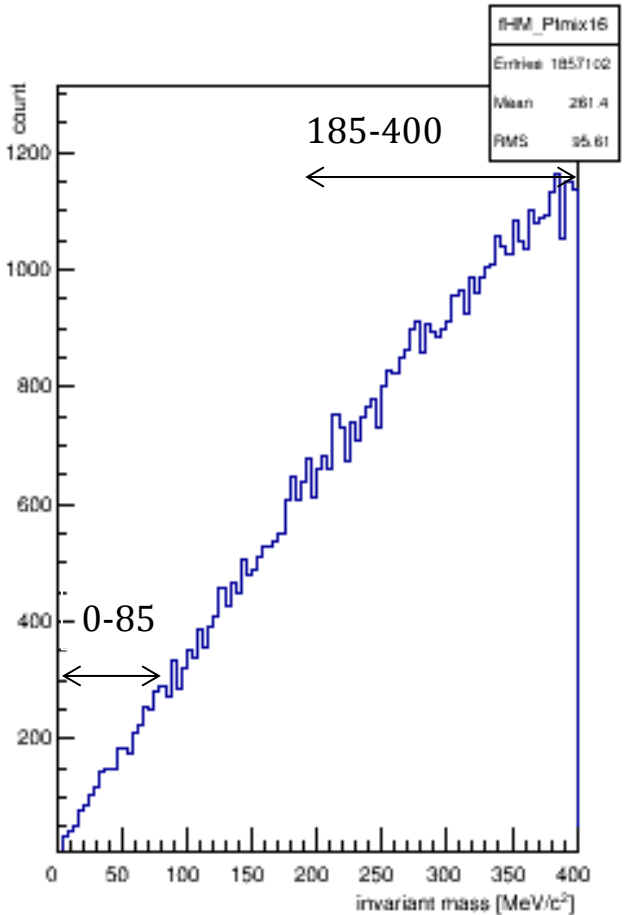cluster2 ↔ cluster3

cluster1 ↔ cluster2

cluster3

— real pair

— mix pair

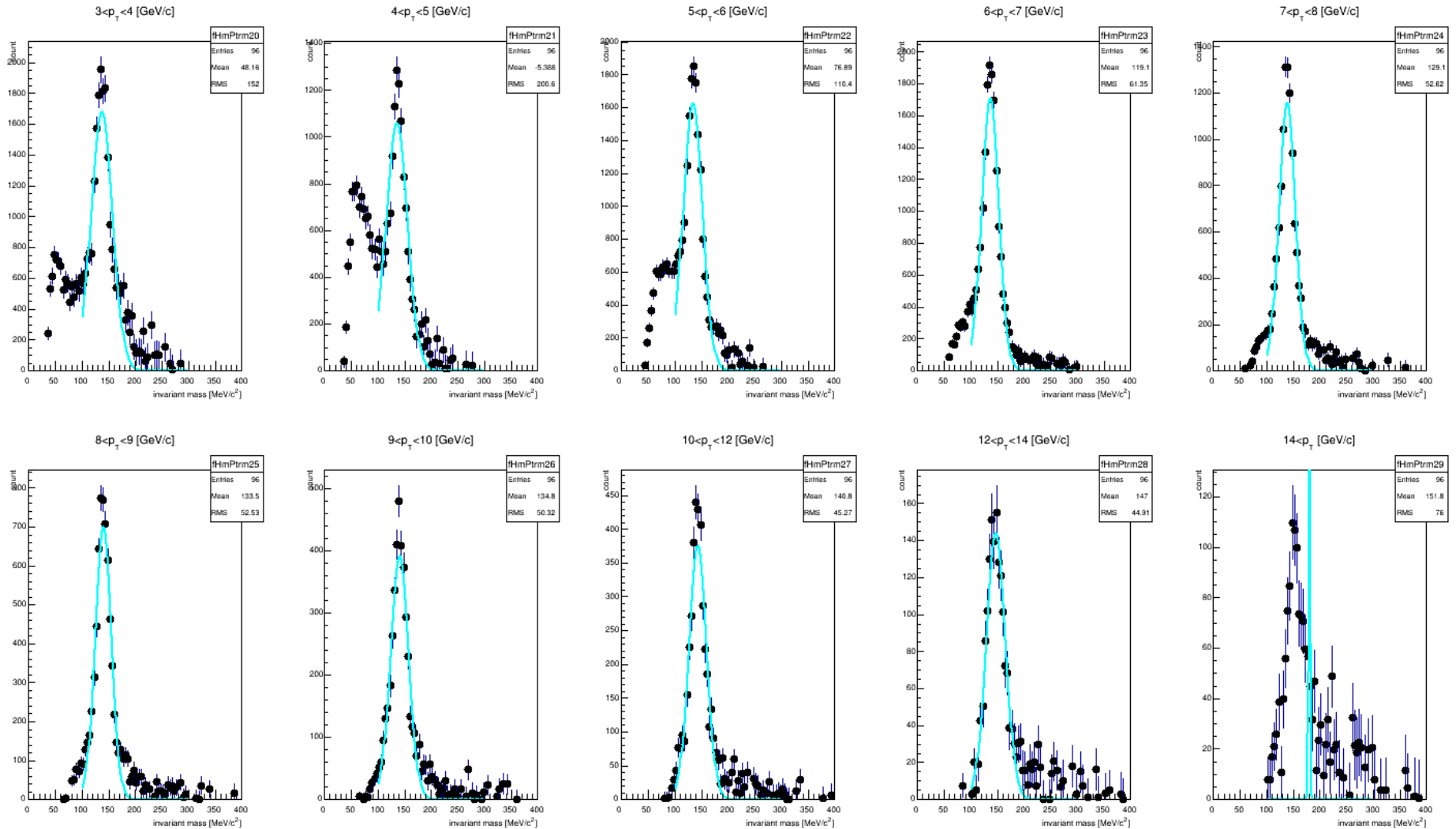normalization example

real event pair

mix event pair

normalization function ; $\dfrac{\sum_0^{85} real + \sum_{185}^{400} real}{\sum_0^{85} mix + \sum_{185}^{400} mix}$
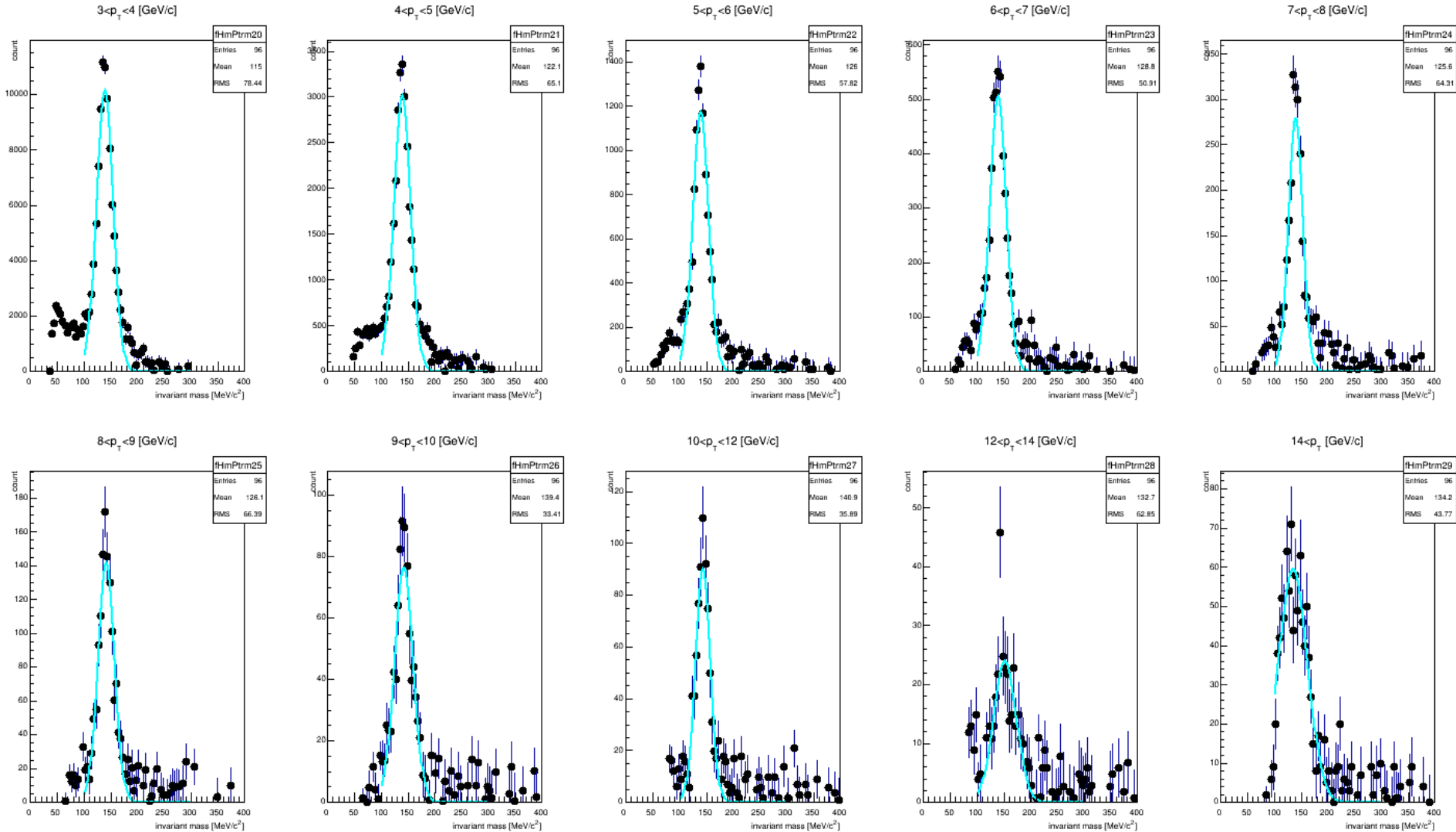
3. Result

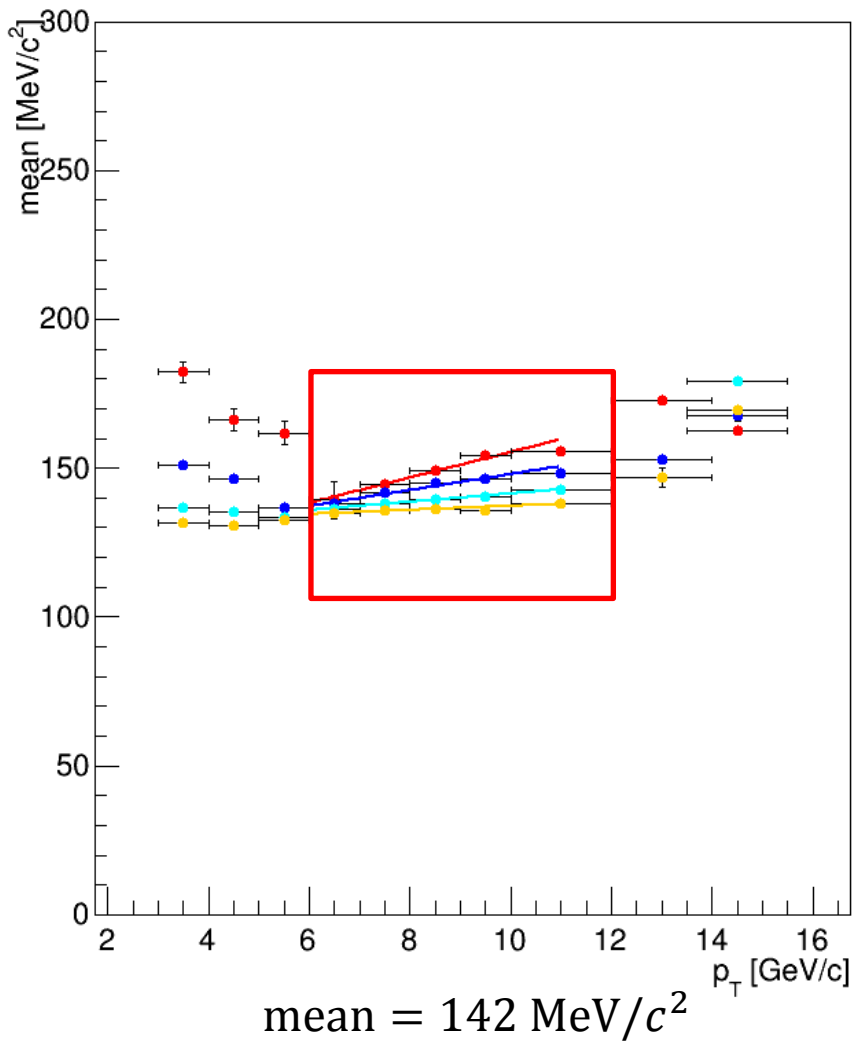EMCal trigger(kEMCEGA)   Centrality 30~60%

3. Result

Minimum bias, Central, Semicentral trigger(kNB, kCentral, kSemiCentral)
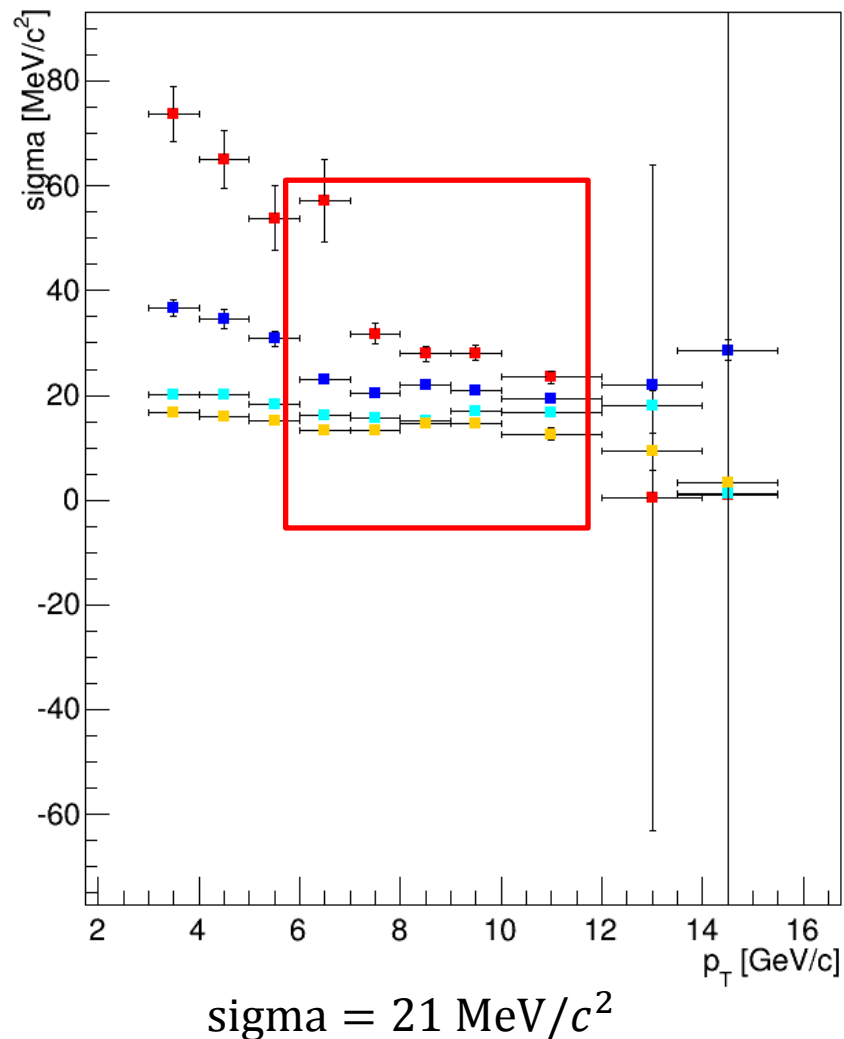
Centrality 30~60%
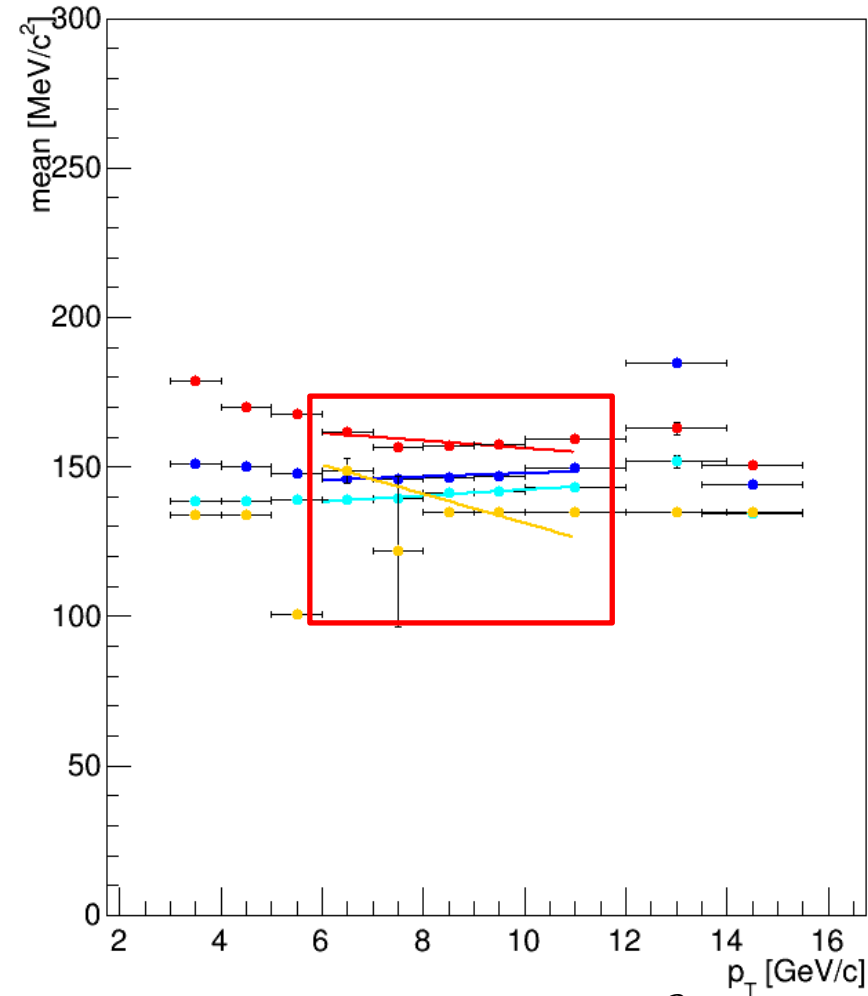
3. Result

pT vs Mean

pT vs Sigma

mean $= 142$ MeV/c^2

sigma $= 21$ MeV/c^2

3. Result
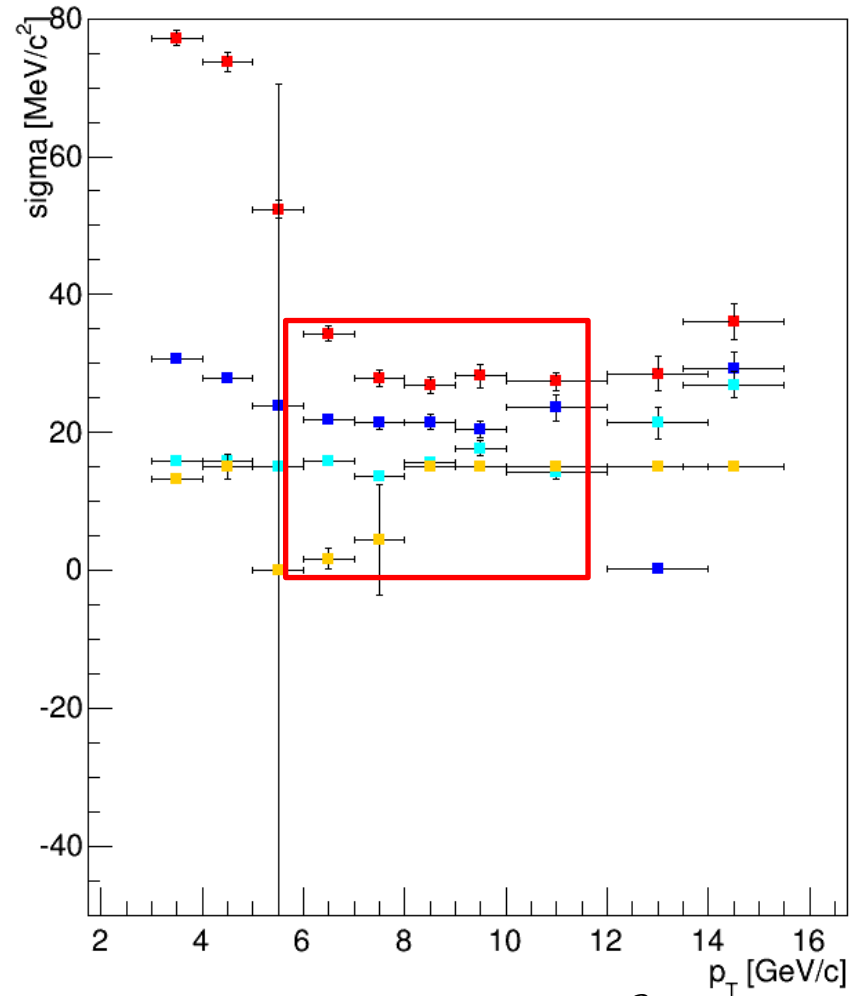
Minimum bias, Central, Semicentral trigger(kNB, kCentral, kSemiCentral)

pT vs Mean

pT vs Sigma

mean = 145 MeV/c^2

mean = 18 MeV/c^2

4. Summary

I reconstructed π^0 generated by Pb+Pb collision.

π^0: EMCal trigger -> $142\pm63\ MeV/c^2$
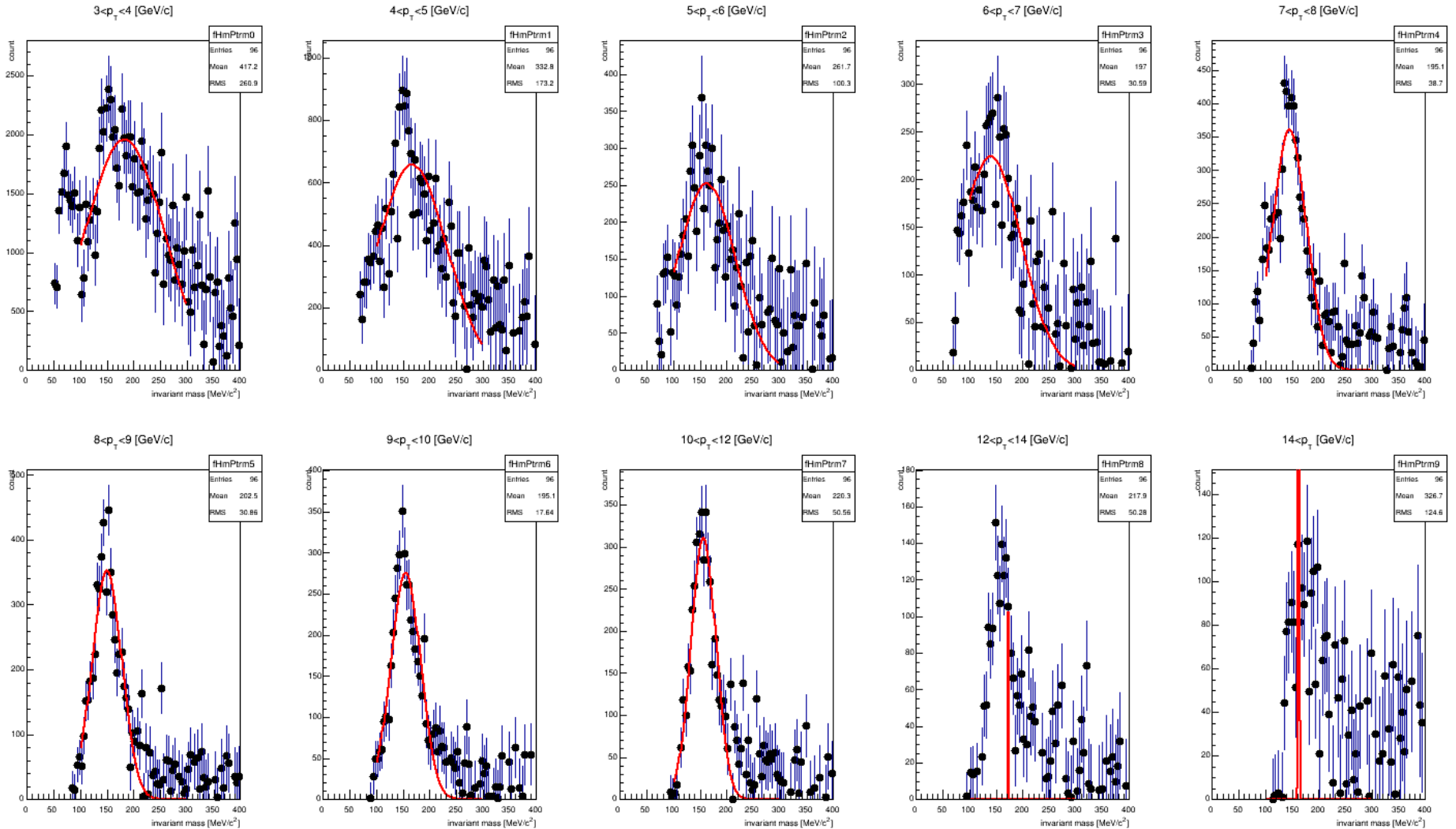　　　Minimum bias,Central trigger -> $145\pm54\ MeV/c^2$

・Next task

increase the number of statistics

separate eventclass finer
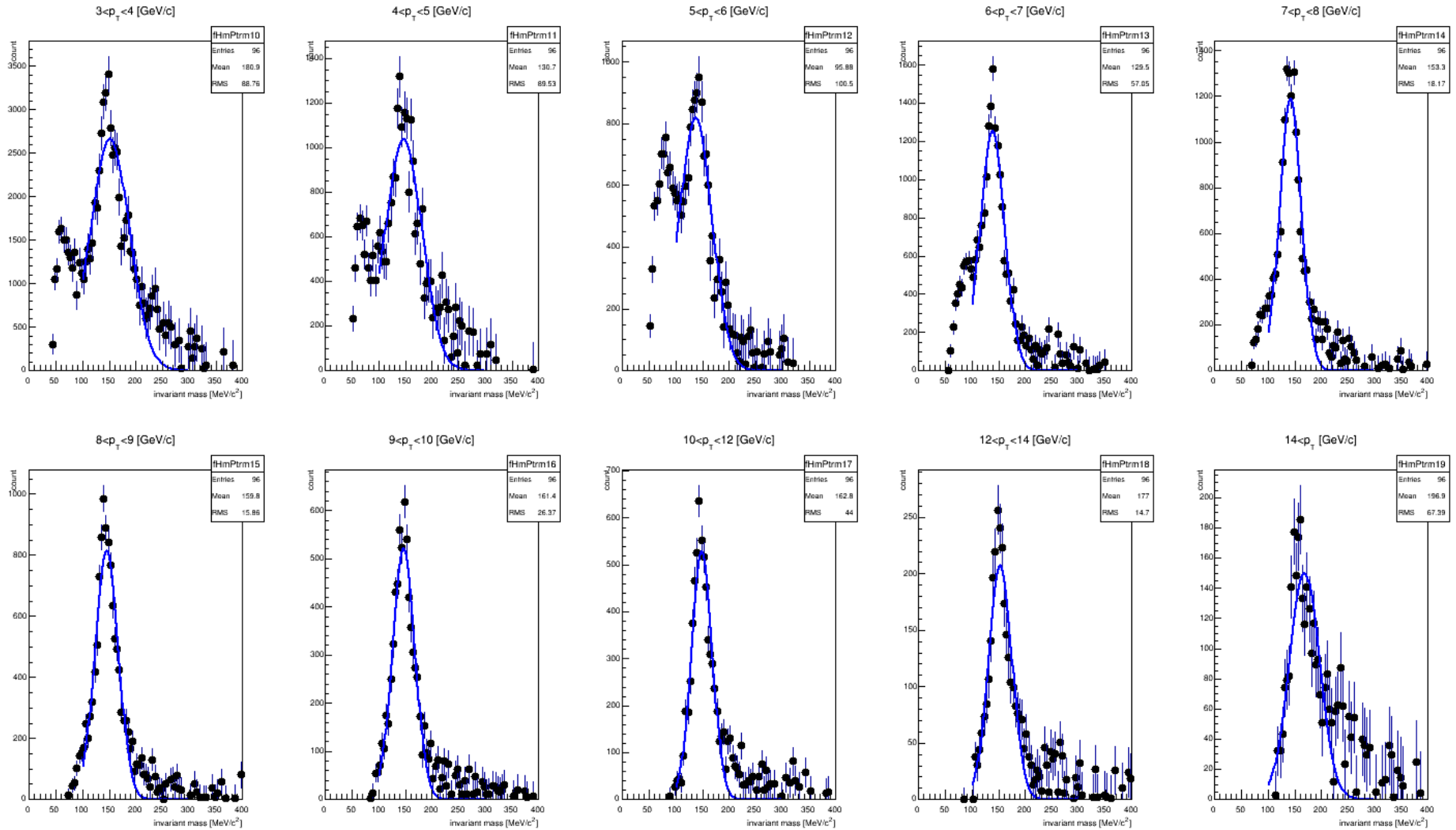
-> improve the accuracy

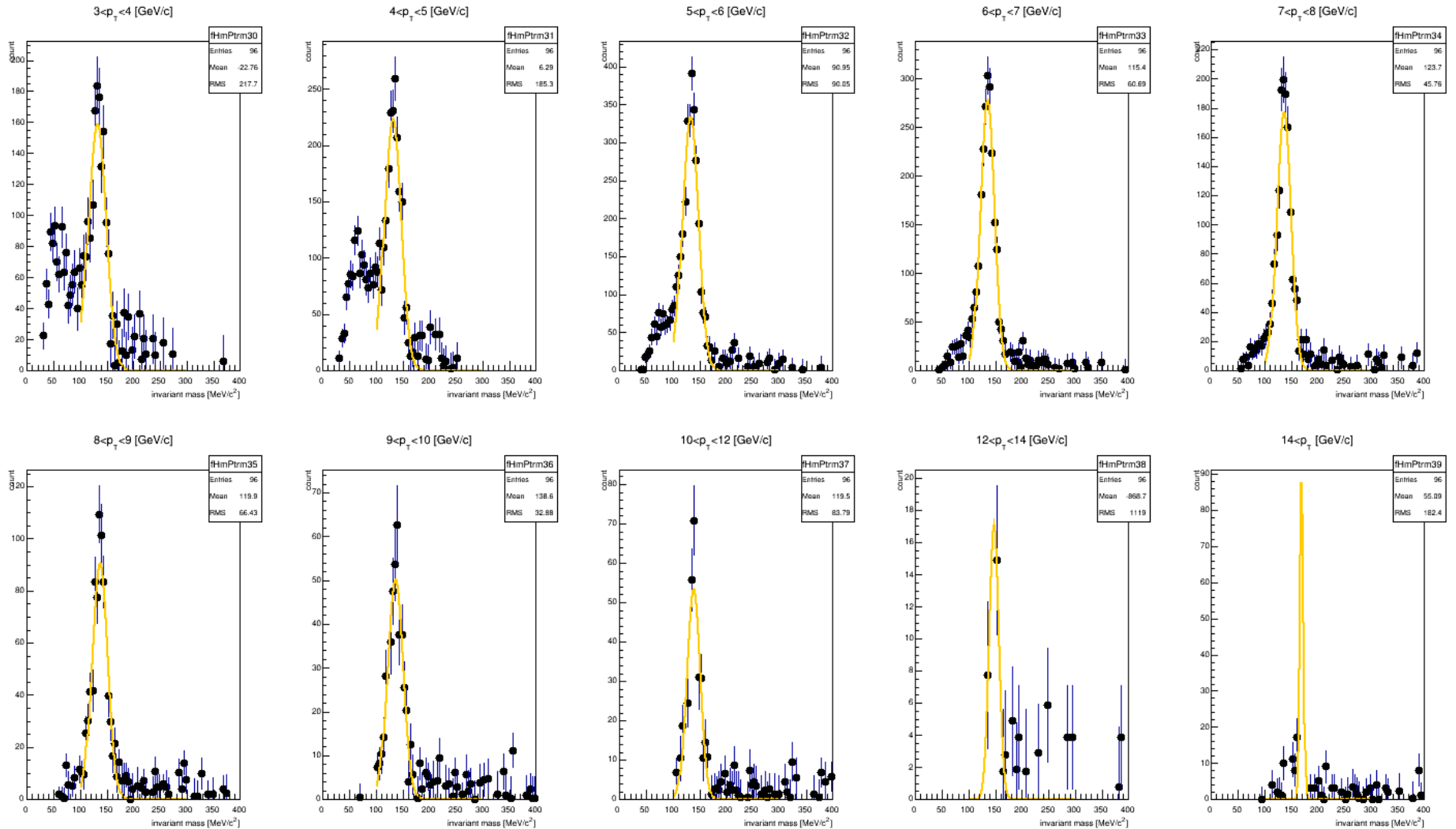EMCal trigger(kEMCEGA)   Centrality 0~10%

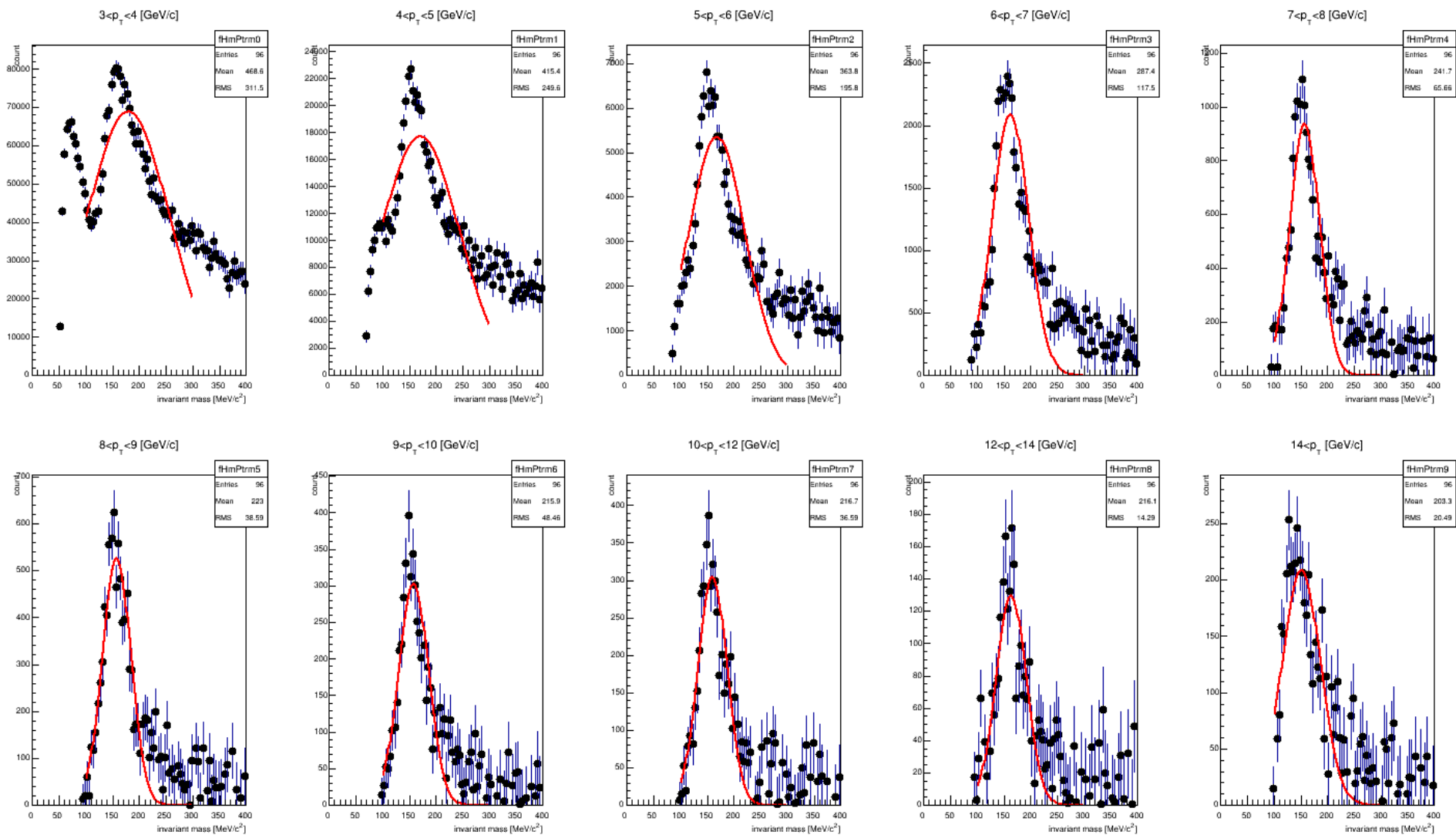EMCal trigger(kEMCEGA)   Centrality 10~30%

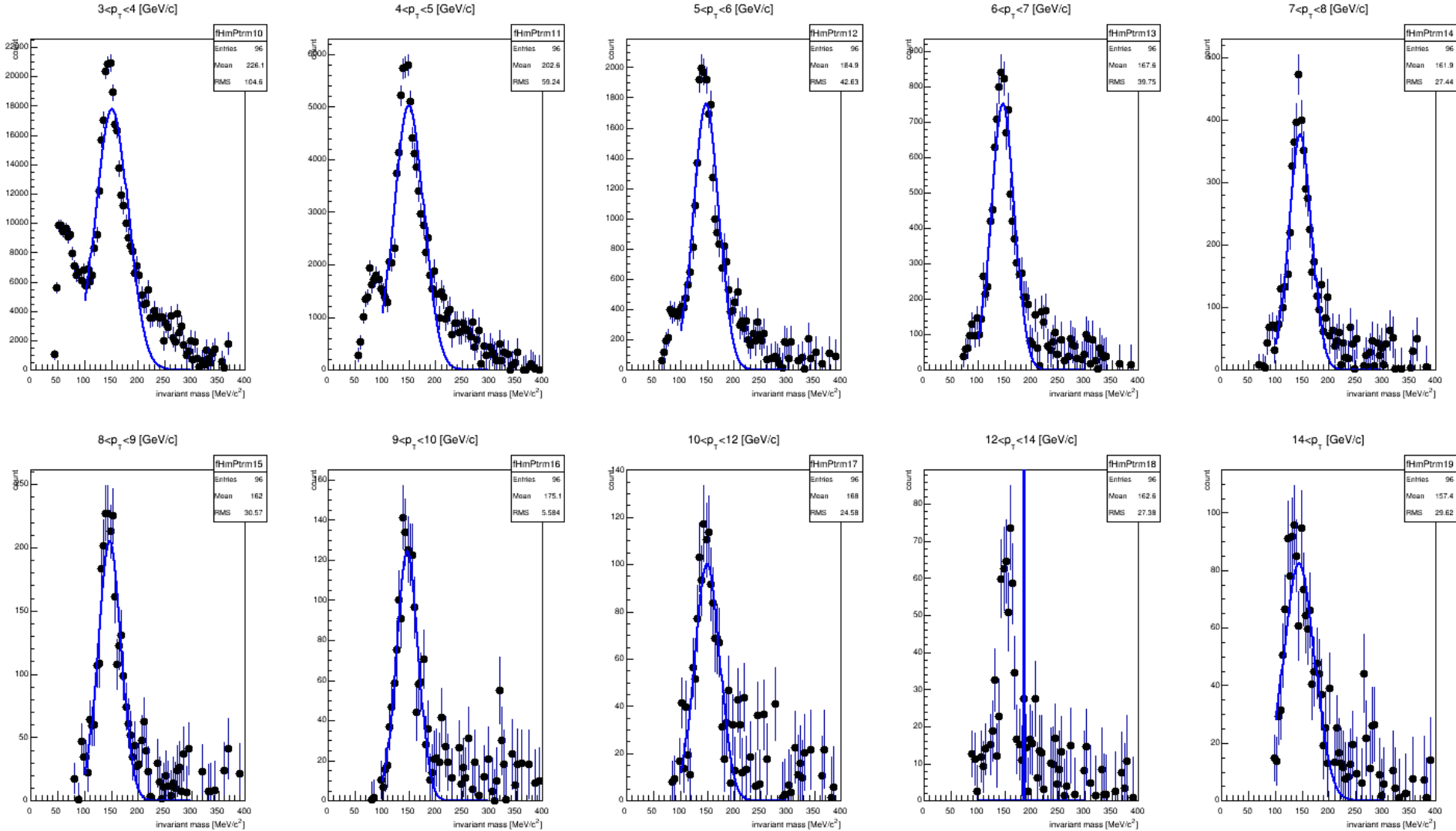EMCal trigger(kEMCEGA)   Centrality 60～100%

Minimum bias, Central, Semicentral trigger(kNB, kCentral, kSemiCentral)
Centrality 0~10%

Minimum bias, Central, Semicentral trigger(kNB, kCentral, kSemiCentral)

Centrality 10~30%

Minimum bias, Central, Semicentral trigger(kNB, kCentral, kSemiCentral)

Centrality 60~100%