Comparison Between GEM with One Station and Three Stations

Nazila Divani,

Andre Ehret, Radoslaw Karabowicz,

Takehiko Saito, Bernd Voss

**Helmholtzzentrum für Schwerionenforschung GmbH (GSI)**

Helmholtz Institute Mainz (HIM)

Motivations

- To investigate if already a single GEM station alone would be helpful or not

- To check ' what if ' only the first station would be installed as a full size prototype at the end of the STT to help it with the very shallow tracks

# Single GEM Station Geometry on the CAD and Its Details
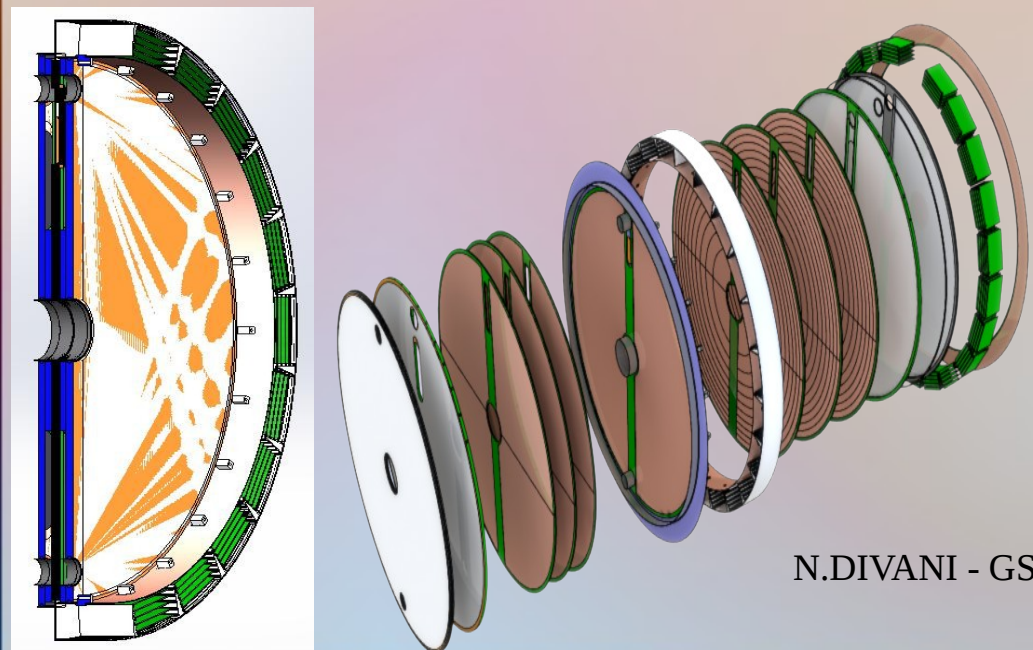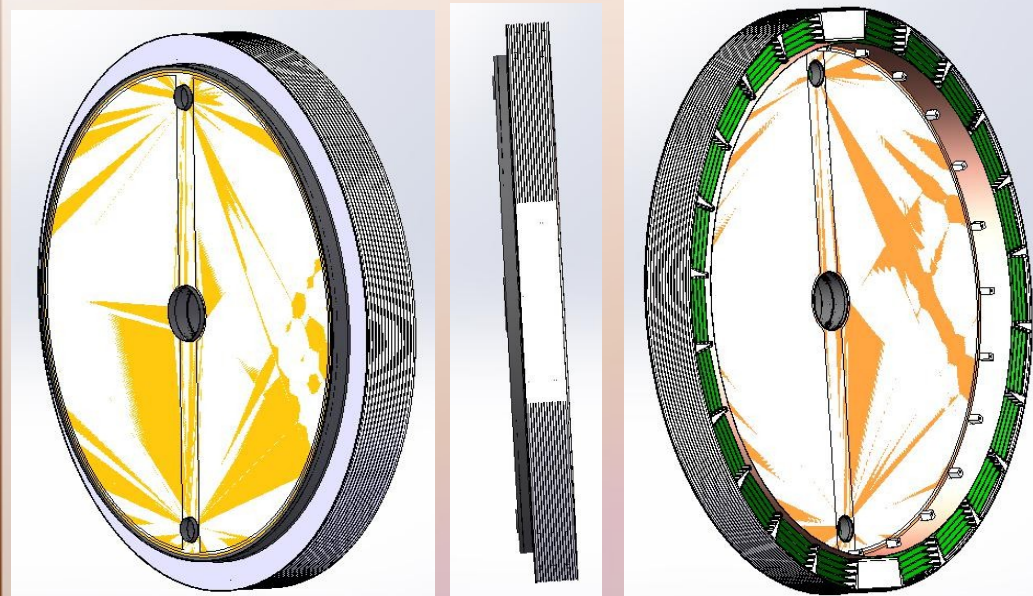
- It consists of one station of planar Gaseous Electron Multipliers as a first forward detector behind central tracker

- To be mounted approximately more than 1m behind the target along the beam axis in a solenoid magnetic field

- The station consists of detector windows, cathodes, GEM foils, sensitive pad planes, $ArCO_2$ gas containers, cooling support and electronic devices

- The double-sided read-out planes is located in the center of station

- Providing strip information on crossing particles in 4 projections: radial and circular (front), horizontal and vertical (back)
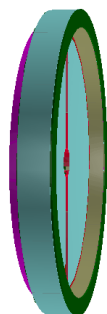
# Single GEM Station Detector Geometry on the Simulation

realistic geometry:
Here , dimensions belong to the first station.
NofLayers = 47 layers
33main layers and 14holding structure layers
all layers with different sizes and thicknesses
DiskInnerRadius = 4.50 cm
DiskOuterRadius = 45.00 cm
DiskZPosition = 119.40 cm
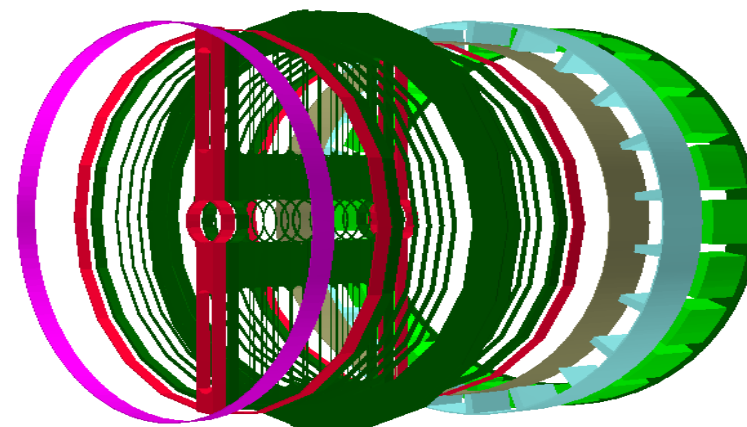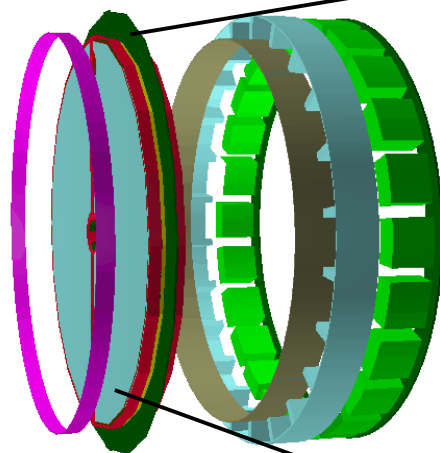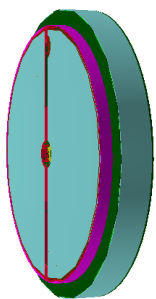
(holding structure layers and the other parts)

Gas container ring bottom
CarbonRingHalfThickness = 1.5 cm
Gas container ring top
CopperRingHalfThickness = 3.75 cm
Segments for electronic parts
SegmentHalfThickness = 0.25 cm
Cooling support ring
AlumiRingHalfThickness = 3.75 cm

(main layers)

N.DIVANI - GSI & HIM

4
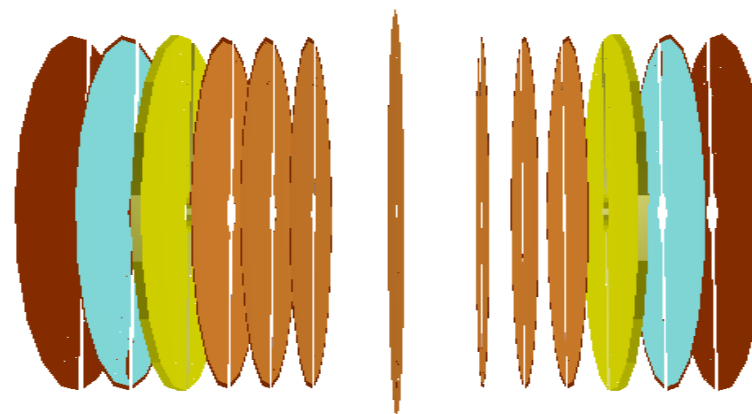
GEM Geometry Simulation and GEM Points Plots (using First Station)
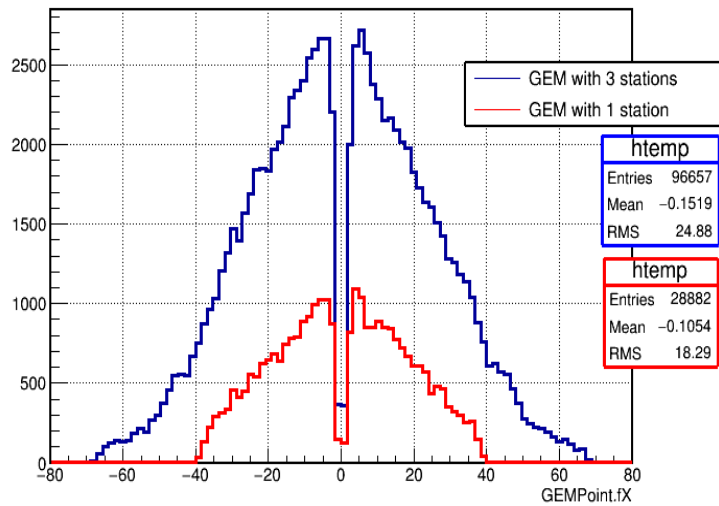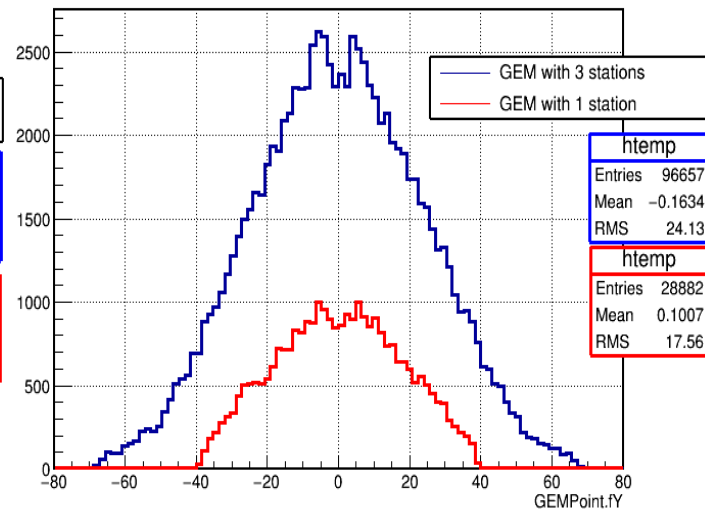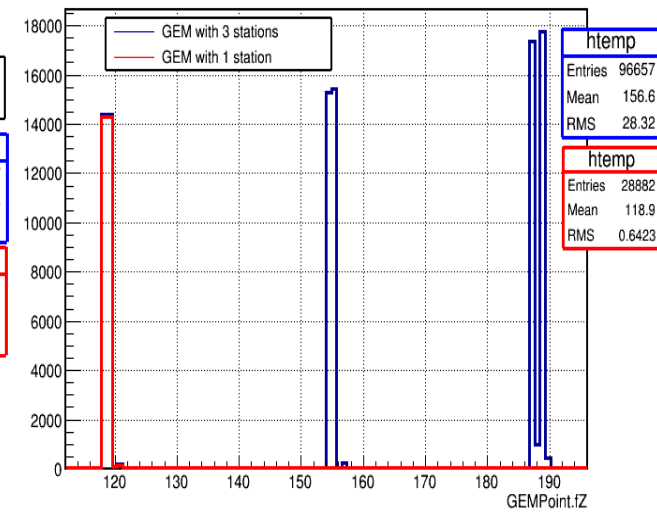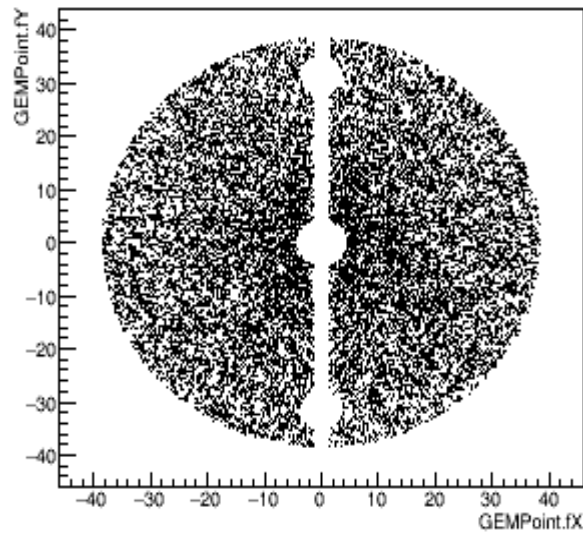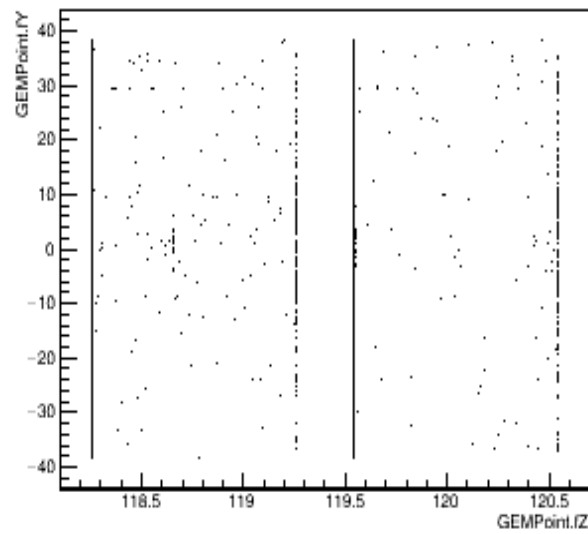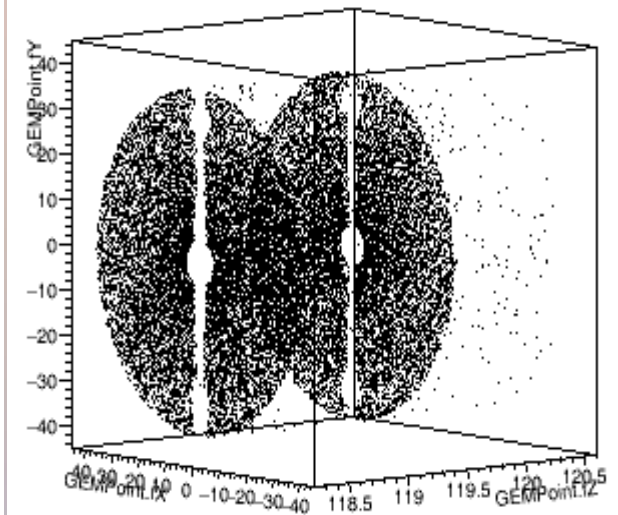
Investigation of Invariant Mass Reconstruction

Benchmark channel including antip+p→ψ(2S)→J/ψ(1S)π+π−, then J/ψ into $\mu+$ and $\mu-$ (muonic decay).The mass of the ψ(2S) and J/ψ(1S) are respectively 3686.109±0.012MeV/c² , 3096.916±0.011MeV/c² .
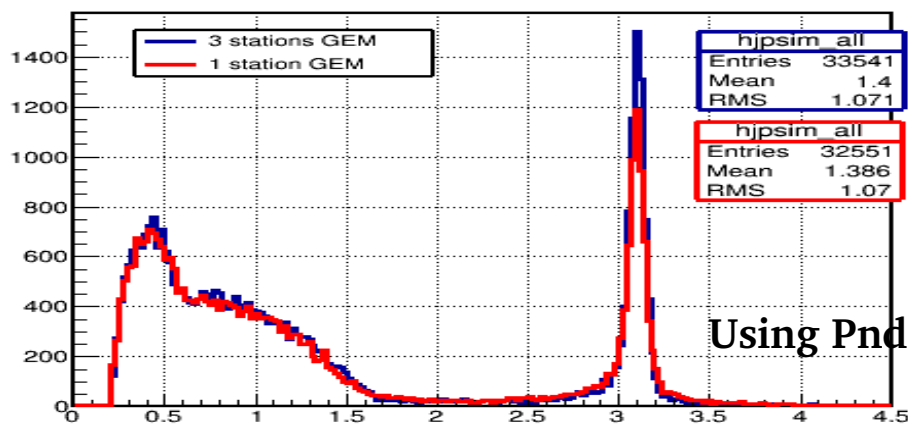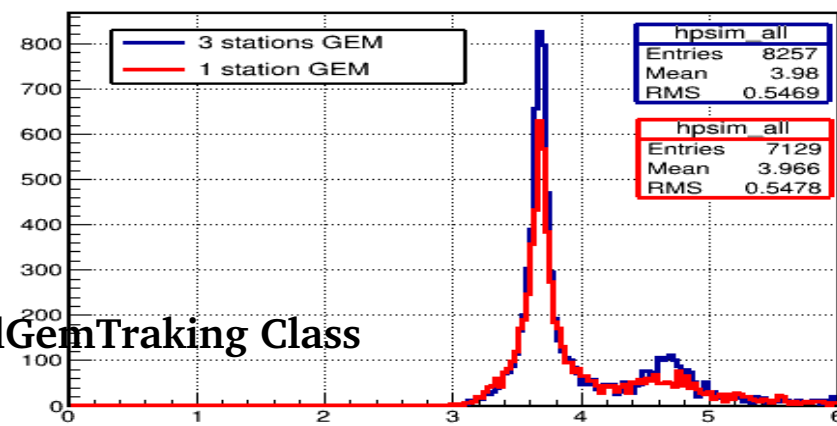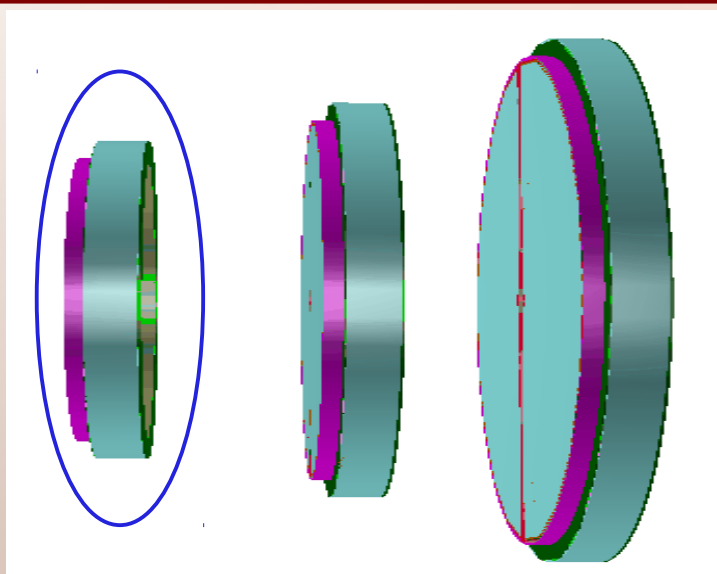

Using PndSttMvdGemTraking Class
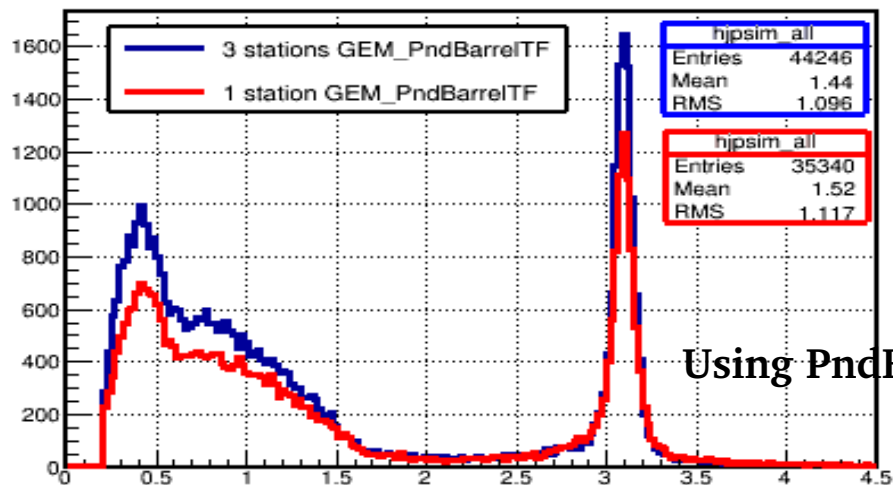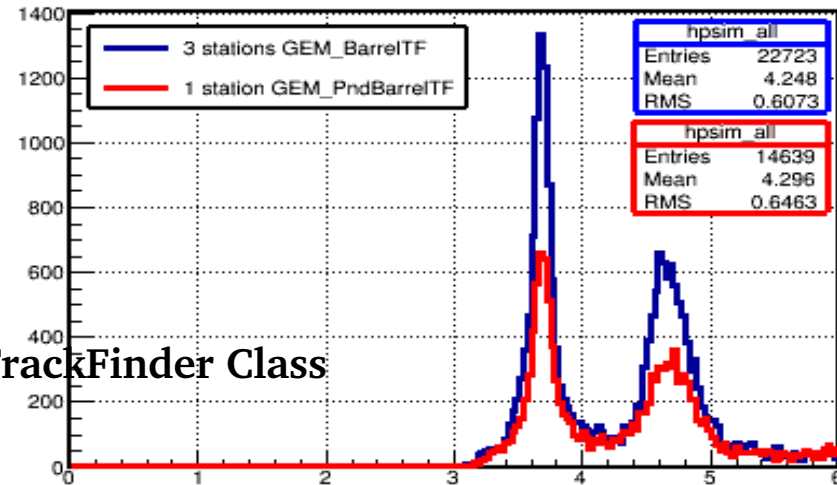
Using PndBarrelTrackFinder Class

Results by Selecting First GEM Station only

First station , second station , third station
Total Outer Radius = { 45.00, 56.00, 74.0 } cm
Z Position = { 119.40, 155.40, 188.50 } cm

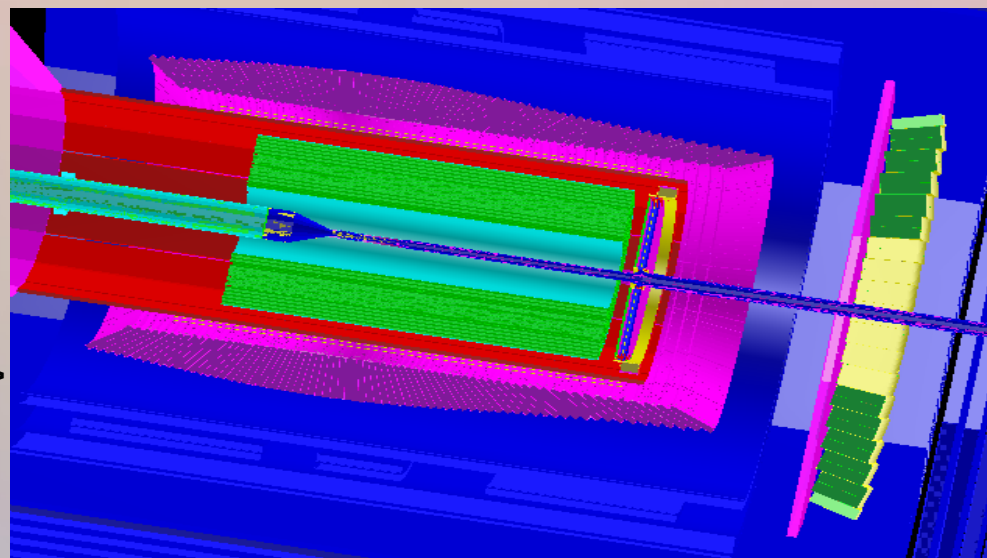- **First GEM Station specs:**

  No. of Layers = 47

  Z Position = 119.4 cm

  Total Inner Radius = 4.5 cm

  Total Outer Radius = 45 cm

  Outer Radius for Sensitive Layer = 38.45 cm
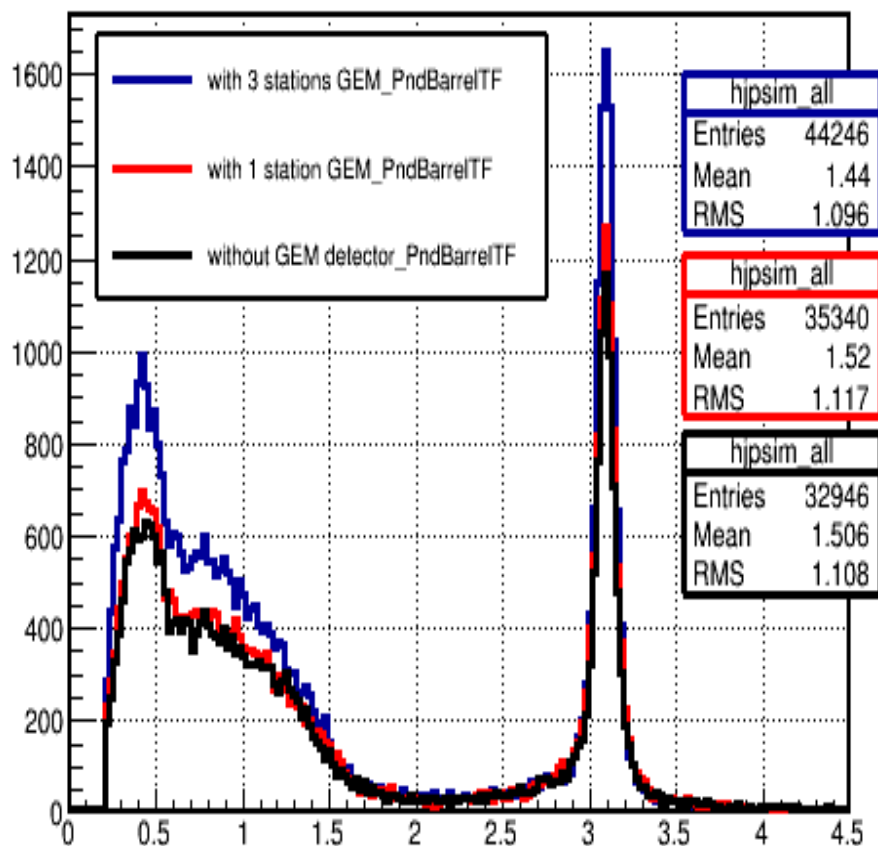
  Covering Polar Angles = 2.16° - 17.85°

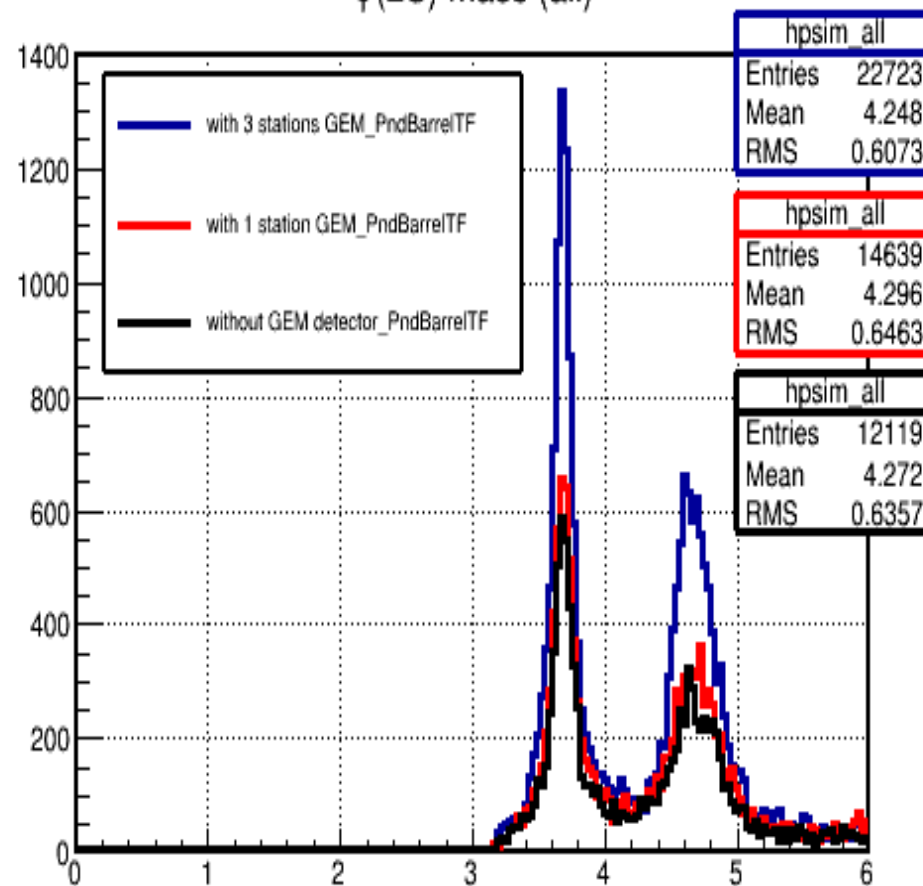

Putting First GEM station at the end of the STT ------>

N.DIVANI - GSI & HIM

7

GSI
GSI Helmholtzzentrum für Schwerionenforschung GmbH

HIM
Helmholtz-Institut Mainz

Comparison for three cases: NoGEM and GEM with 1 station and 3 stations

Selecting First GEM Station

Comparison for three cases: NoGEM and GEM with 1 station and 3 stations
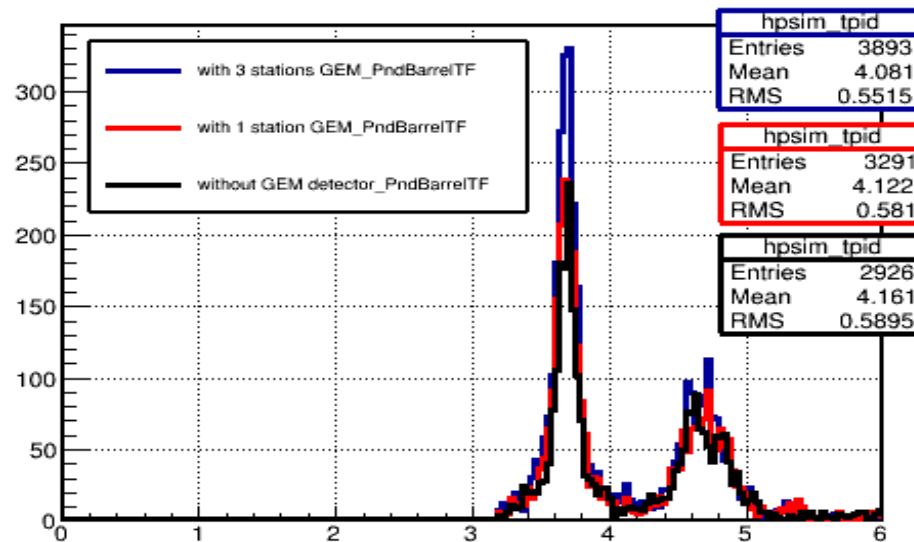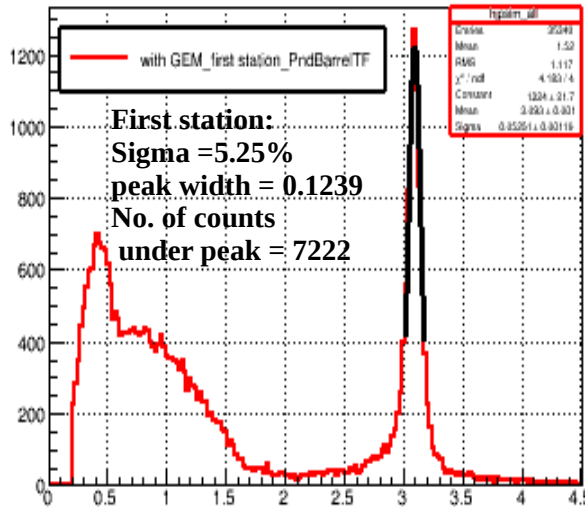
Selecting First GEM Station

Comparison for three cases: NoGEM and GEM with 1 station and 3 stations

Selecting First GEM Station

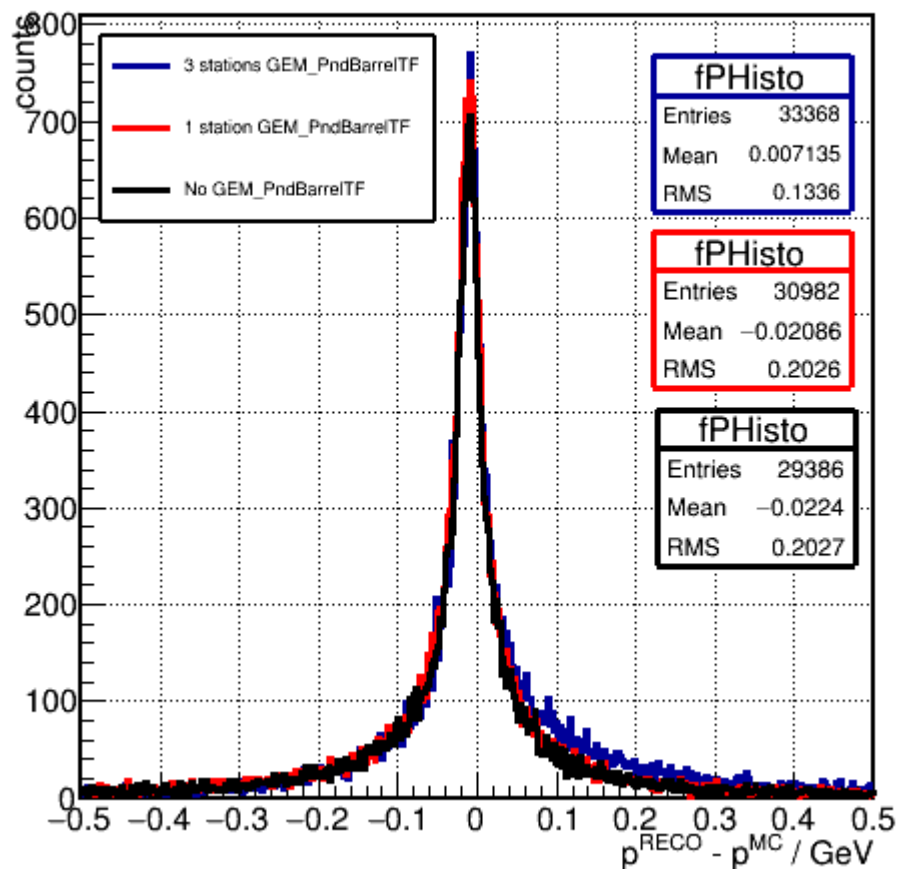GSI Helmholtzzentrum für Schwerionenforschung GmbH

HIM Helmholtz-Institut Mainz

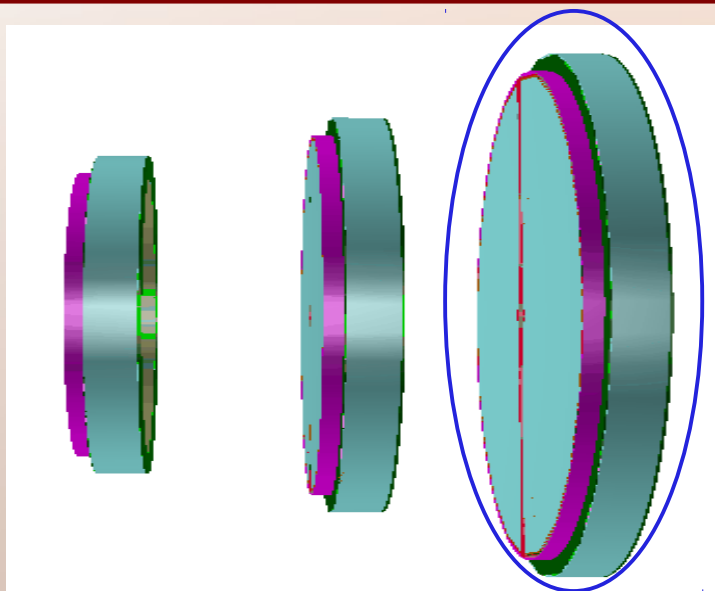## Comparison for three cases: NoGEM and GEM with 1 station and 3 stations

Selecting GEM First Station
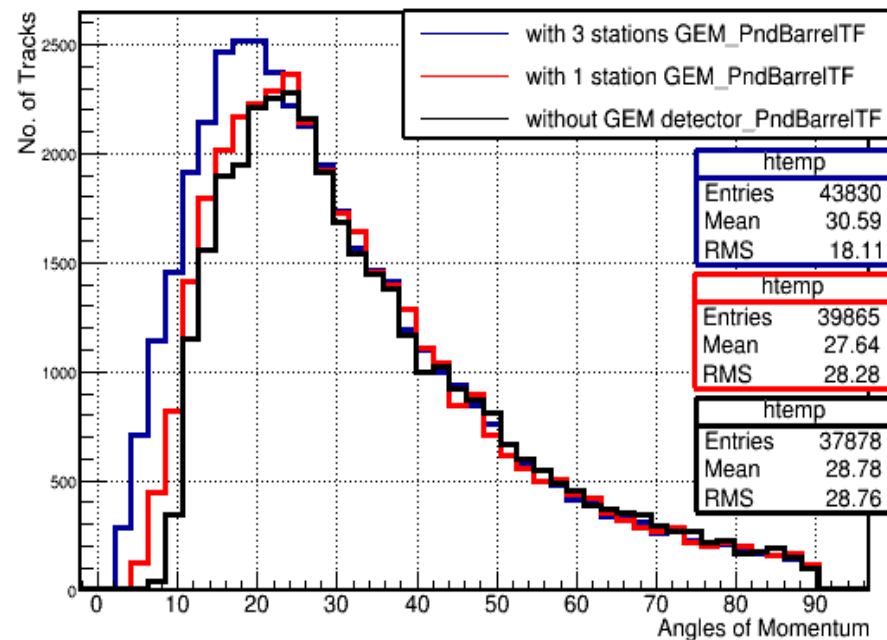
The important thing to be seen from this plot is: using 3 GEM stations can cover the angles below 20 degrees better than the other cases

Results by Selecting the Last GEM Station only

- **Last GEM Station specs:**

  No. of Layers = 47

  Z Position = 188.5 cm

  Total Inner Radius = 4.5 cm

  Total Outer Radius = 74 cm

  Outer Radius for Sensitive Layer = 67.45 cm

  Covering Polar Angles = 1.37° - 19.69°

First station , second station , third station
Total Outer Radius = { 45.00, 56.00, 74.0 } cm
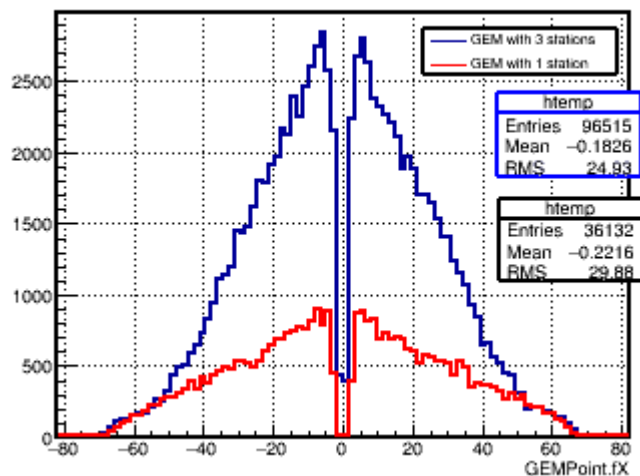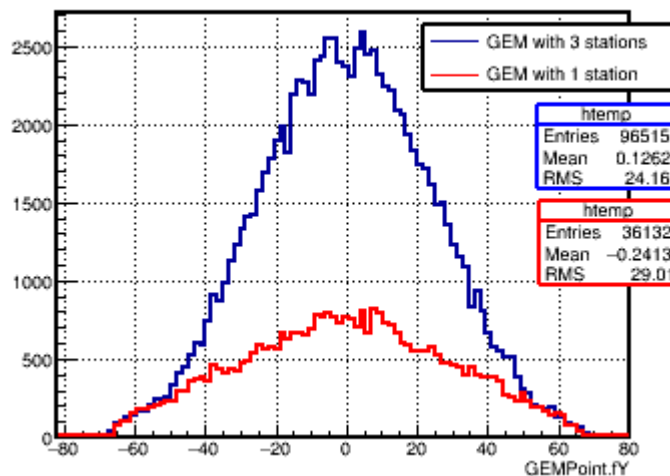**Z Position = { 119.40, 155.40, 188.50 } cm**
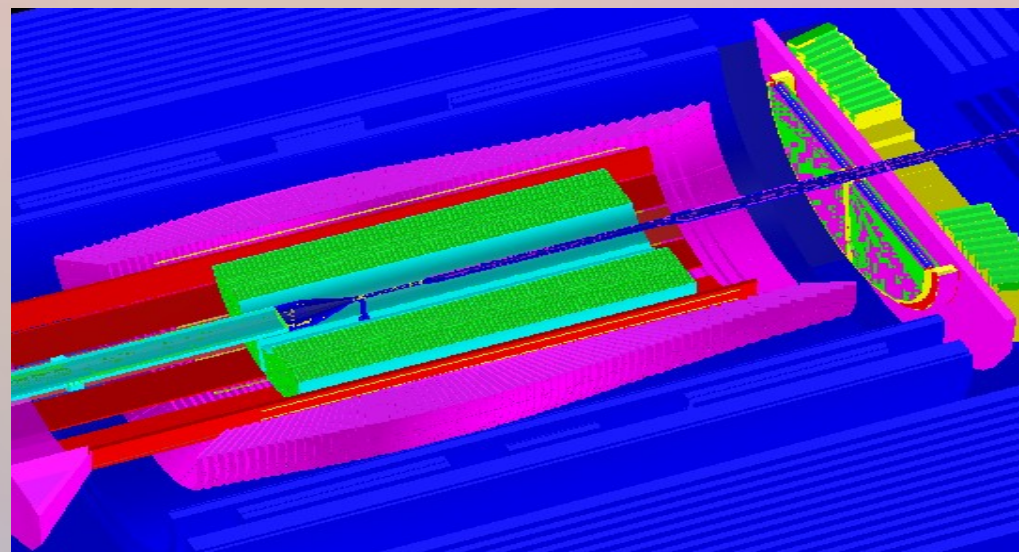
Putting Last GEM station far from the STT -------->

N.DIVANI - GSI & HIM

GEM Geometry Simulation and GEM Points Plots (using Last Station)
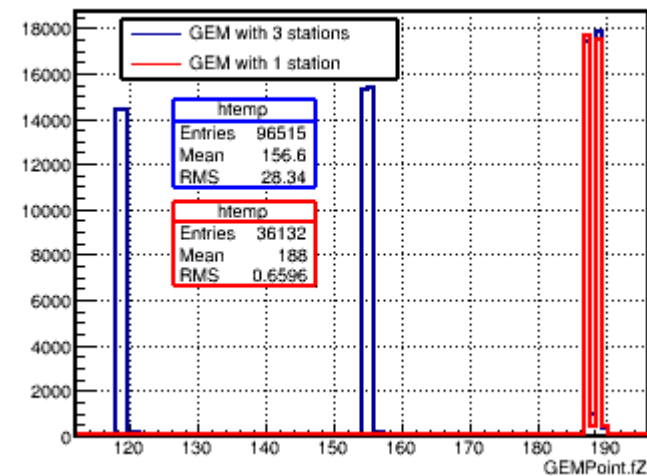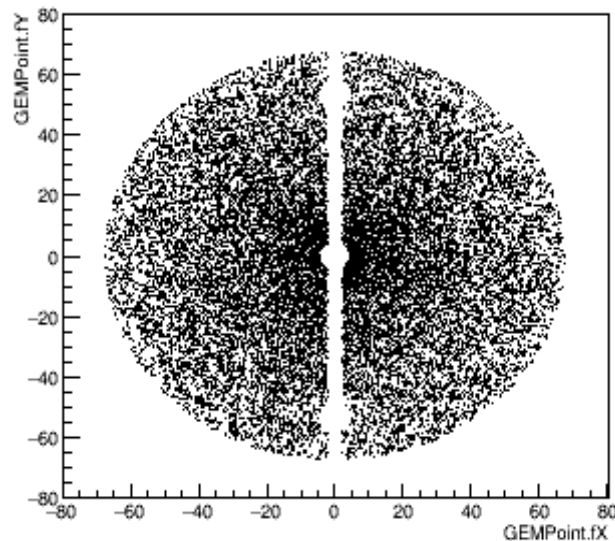
Comparison for three cases: NoGEM and GEM with 1 station and 3 stations

Selecting Last GEM Station

PANDA LVI. Collaboration Meeting – Bochum
February 29 - March 4, 2016

GSI
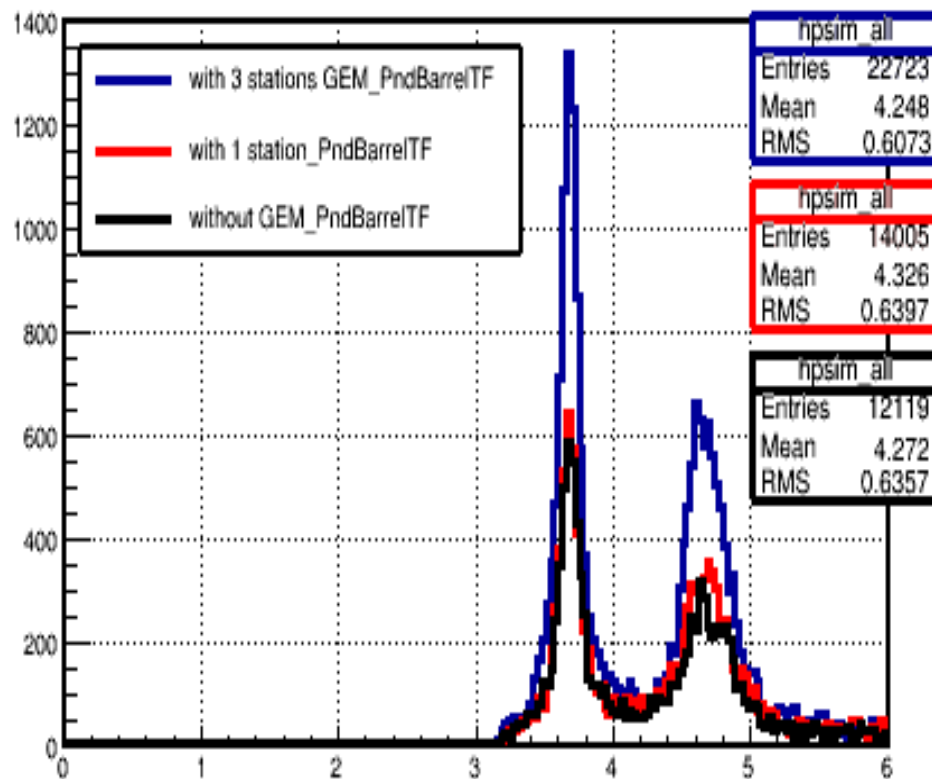GSI Helmholtzzentrum für Schwerionenforschung GmbH

HIM
Helmholtz-Institut Mainz

Comparison for three cases: NoGEM and GEM with 1 station and 3 stations
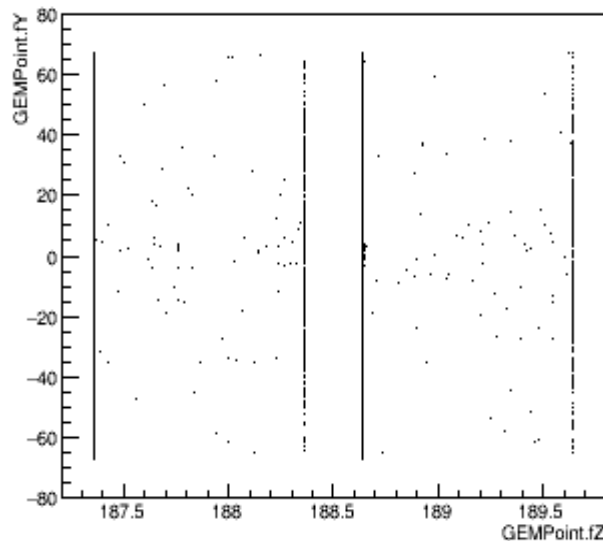
Selecting Last GEM Station
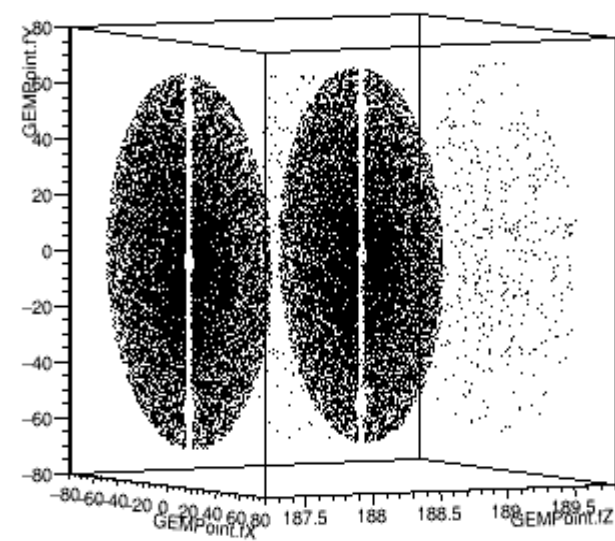
Comparison for three cases: NoGEM and GEM with 1 station and 3 stations
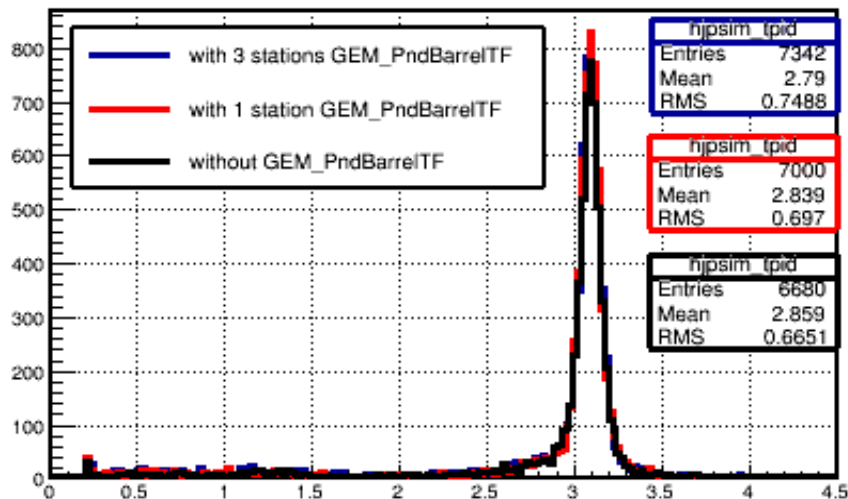
Selecting Last GEM Station

J/ψ mass (all)
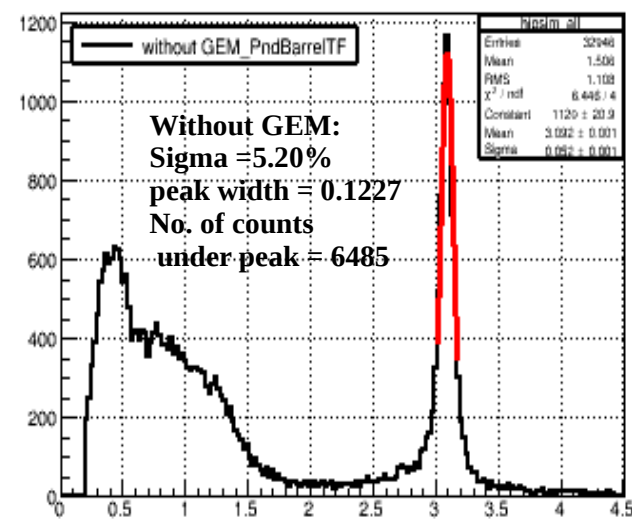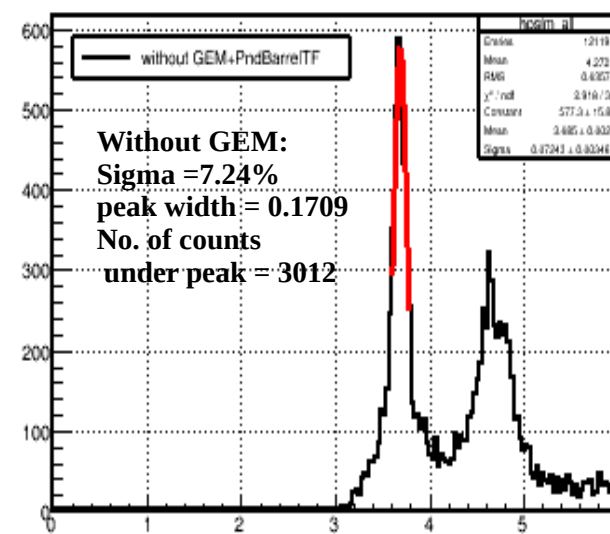
3stationsGEM:
Sigma =4.93%
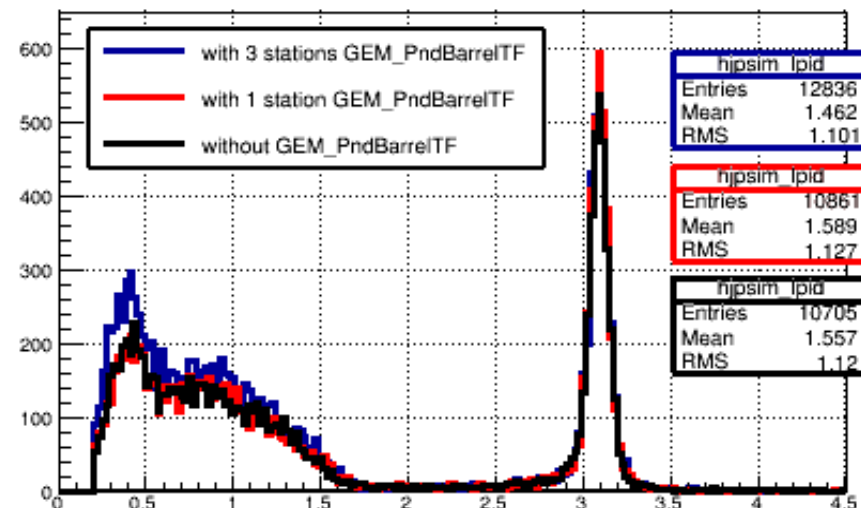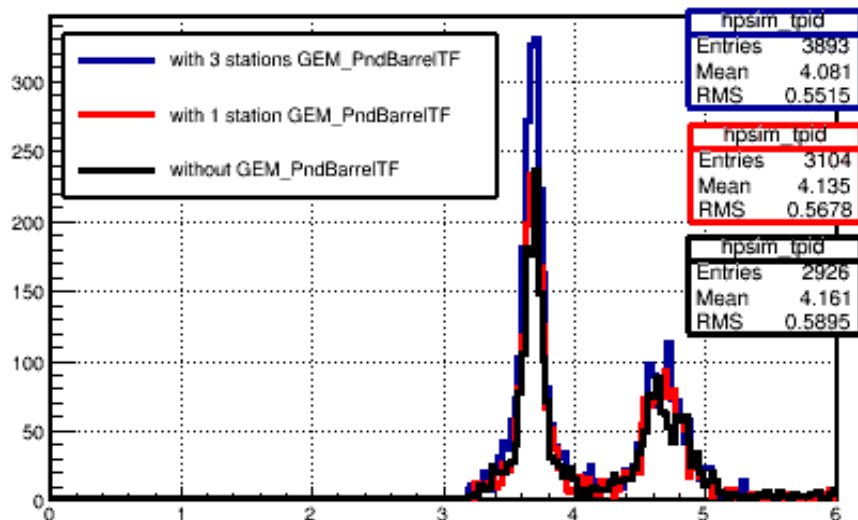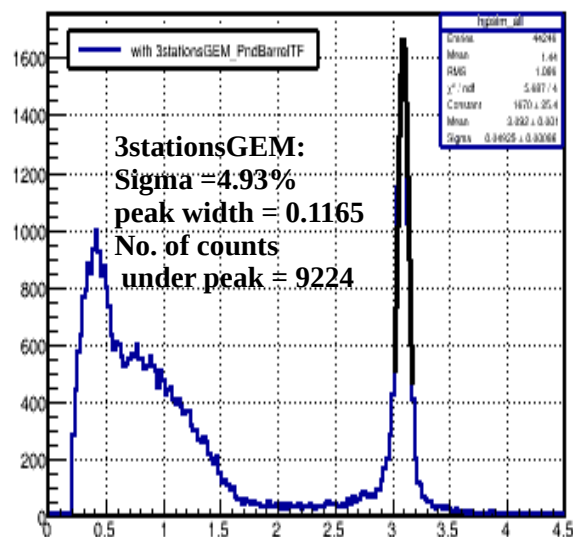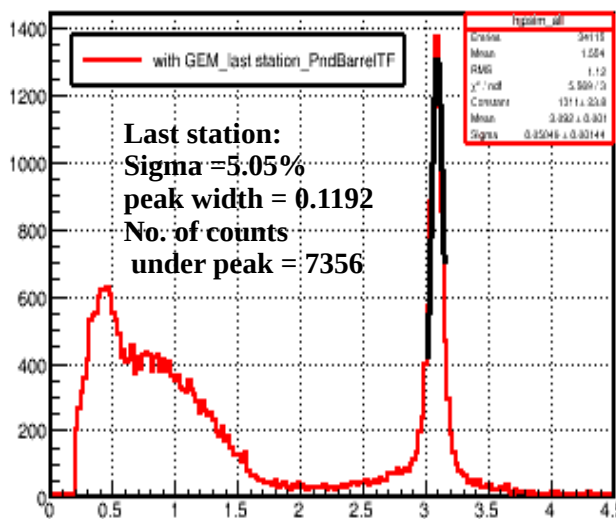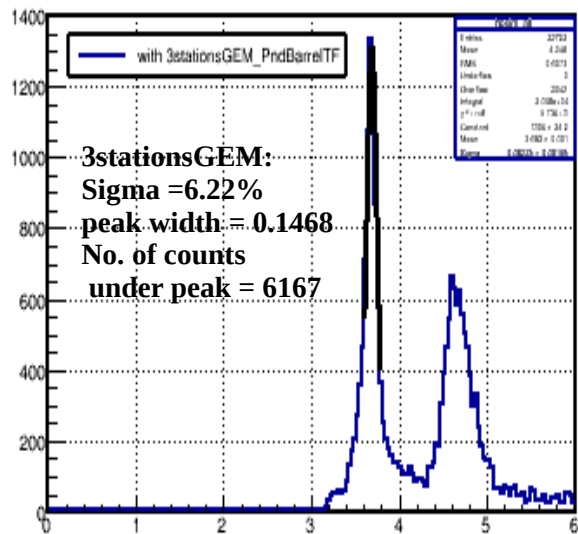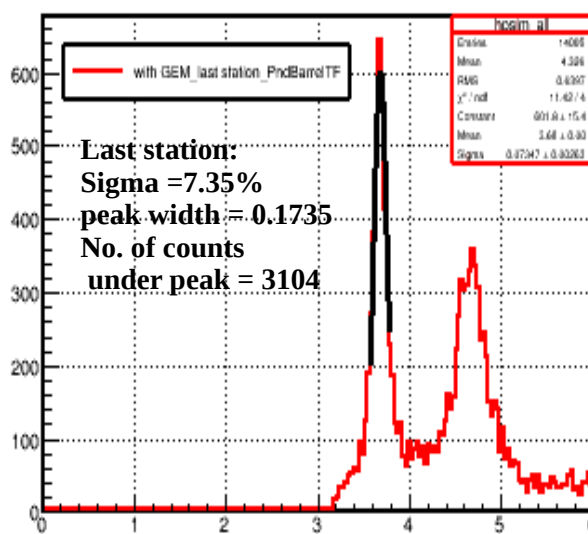peak width = 0.1165
No. of counts
 under peak = 9224

Last station:
Sigma =5.05%
peak width = 0.1192
No. of counts
 under peak = 7356

Without GEM:
Sigma =5.20%
peak width = 0.1227
No. of counts
 under peak = 6485

ψ(2S) mass (all)

3stationsGEM:
Sigma =6.22%
peak width = 0.1468
No. of counts
 under peak = 6167

Last station:
Sigma =7.35%
peak width = 0.1735
No. of counts
 under peak = 3104

Without GEM:
Sigma =7.24%
peak width = 0.1709
No. of counts
 under peak = 3012
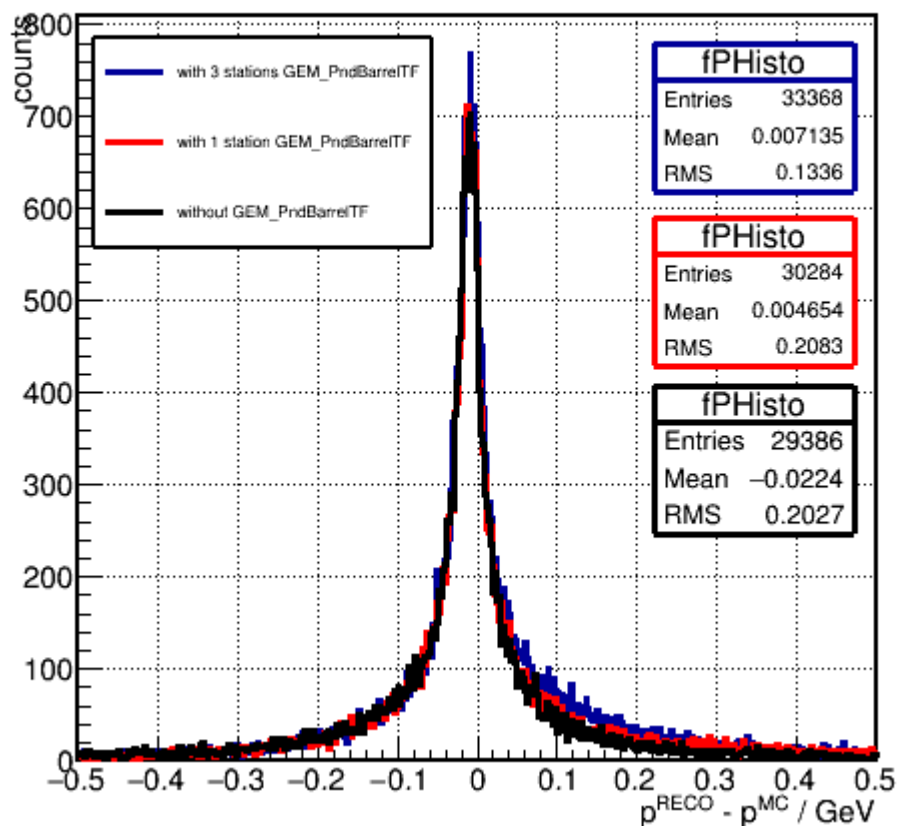
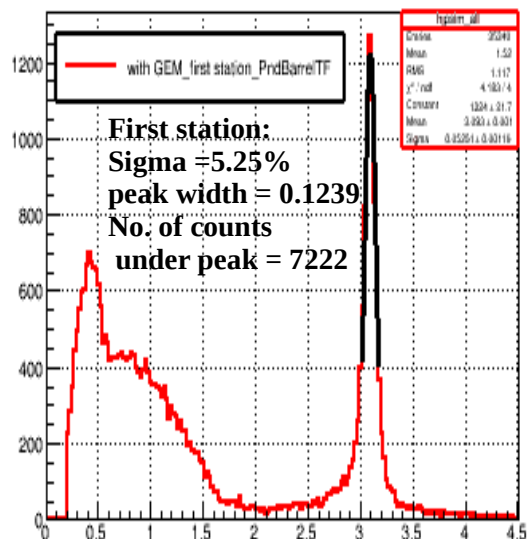## Comparison for three cases: NoGEM and GEM with 1 station and 3 stations

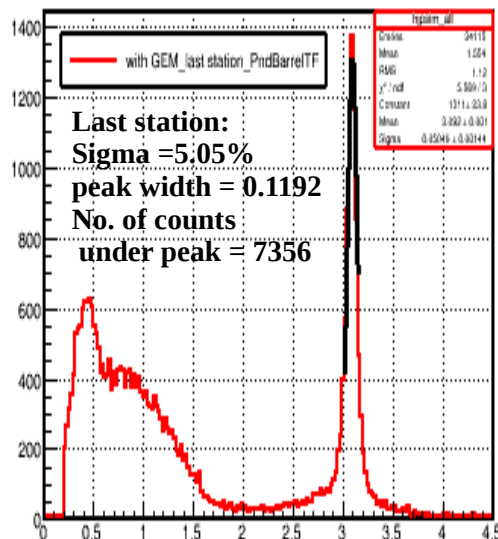**Selecting Last GEM Station**
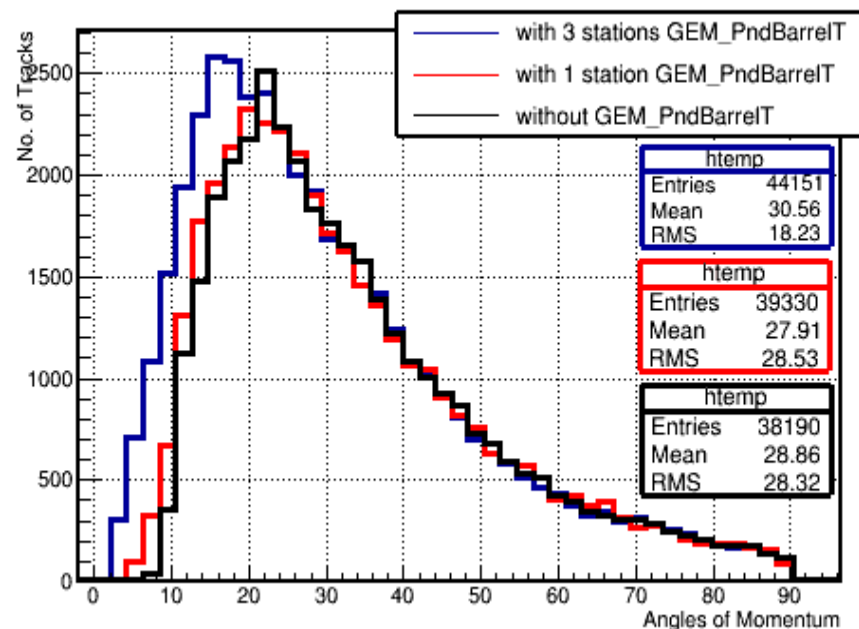
The important thing to be seen from this plot is: using 3 GEM stations can cover the angles below 20 degrees better than the other cases

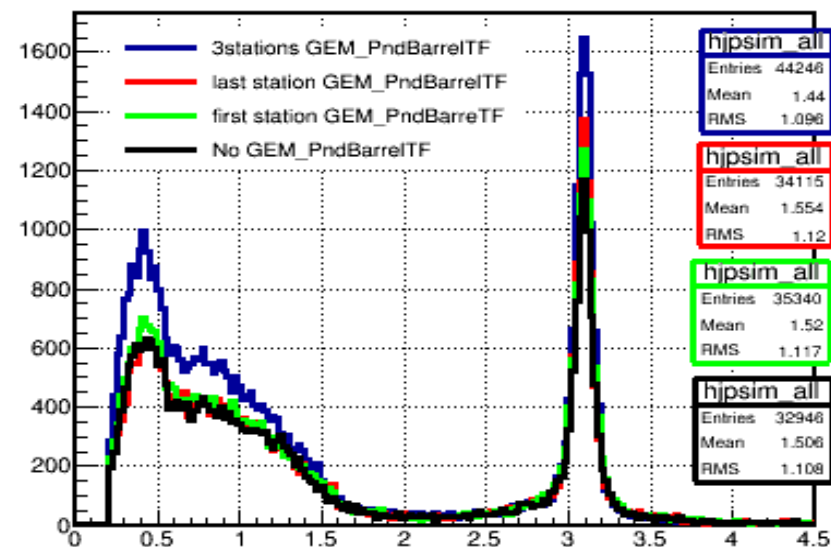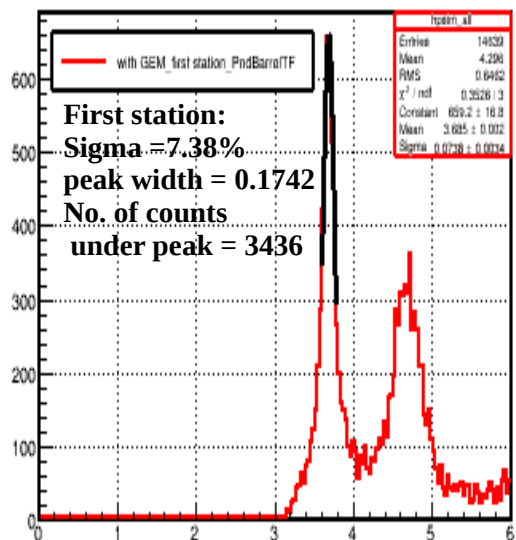# Comparison for first station and last station
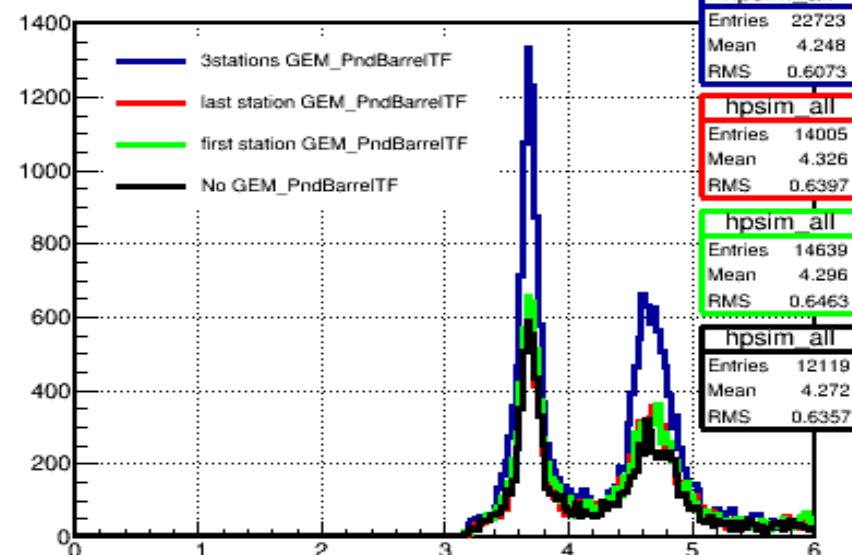
Conclusion

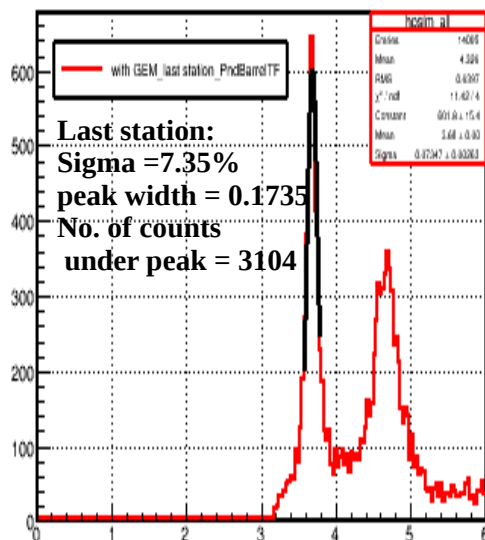- The GEM geometry with only single station has been implemented in the MC simulation.
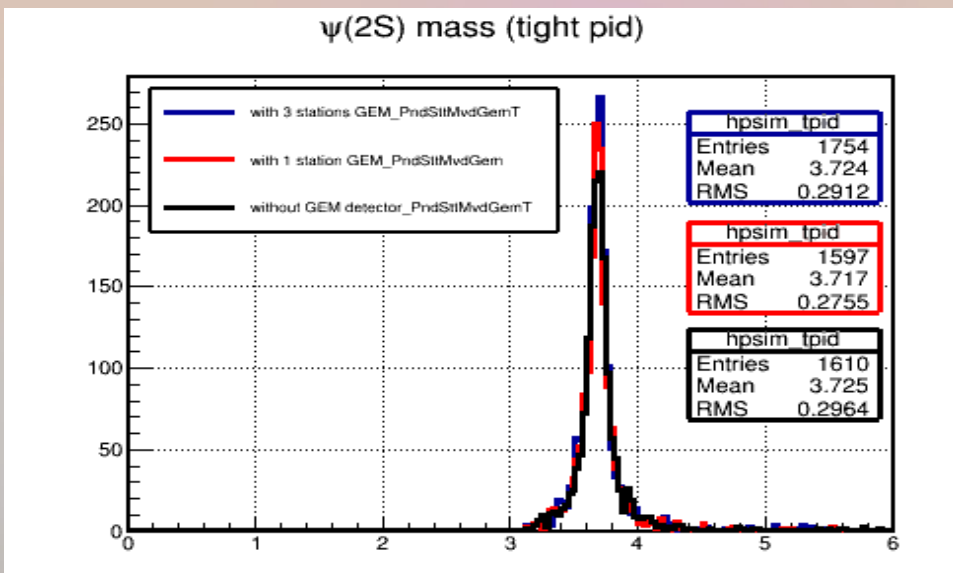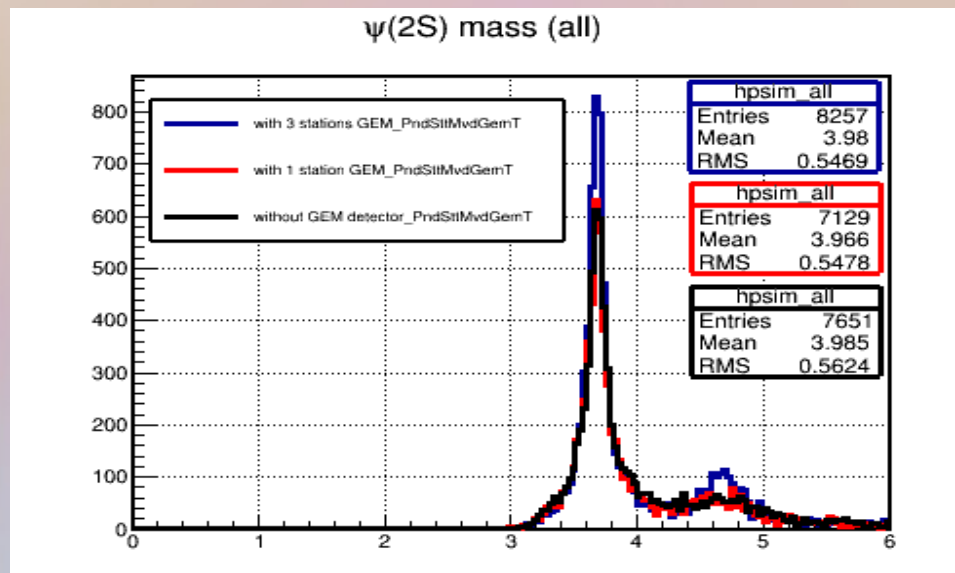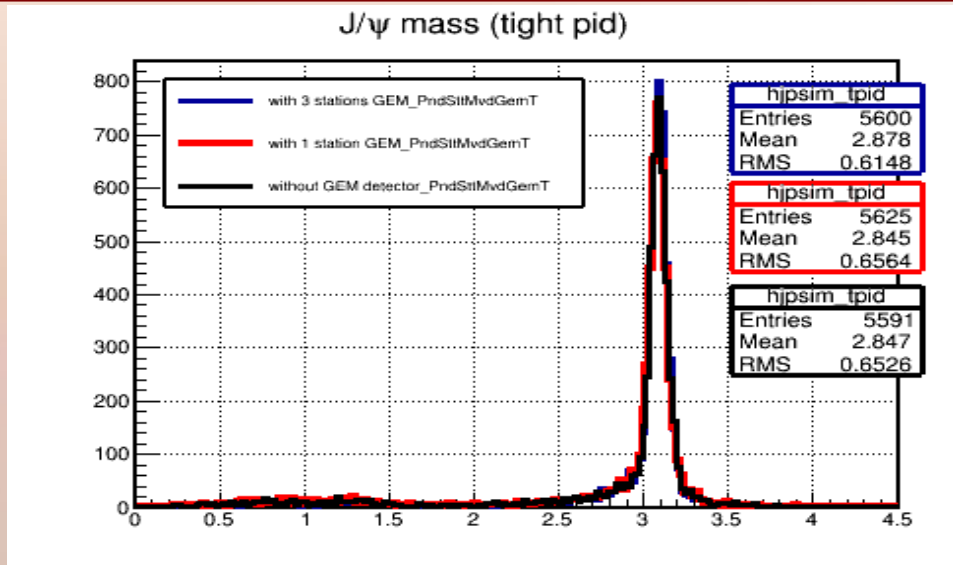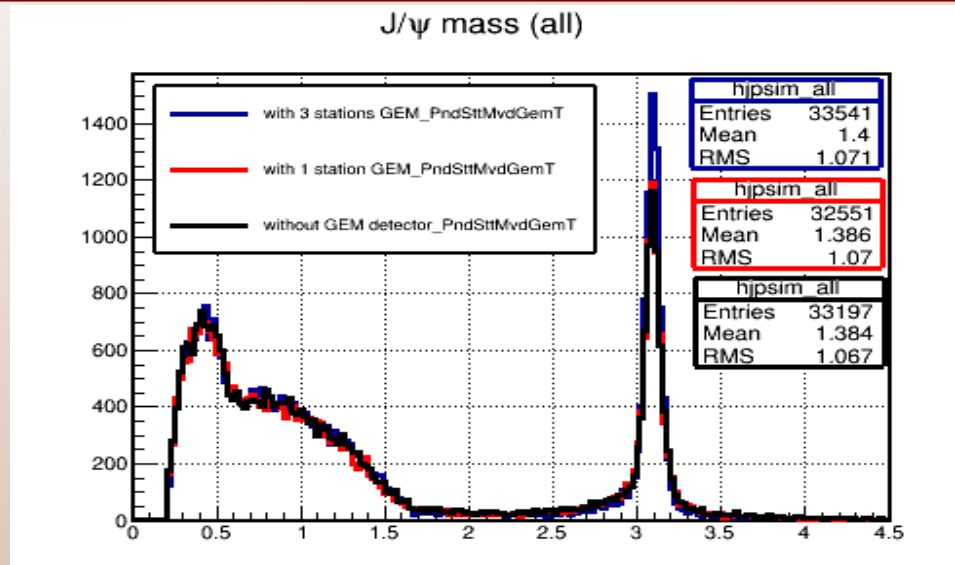
- With 1 station GEM geometry, mass resolution and tracking acceptance:

  - are almost similar to those without GEM.

  - are worse than those with 3 stations GEM.

- It seems to improve PANDA experiment mass resolution, using only GEM with one station is not sufficient.

- By this study , It at least seems using last GEM station can be a little more beneficial than the using first GEM station.

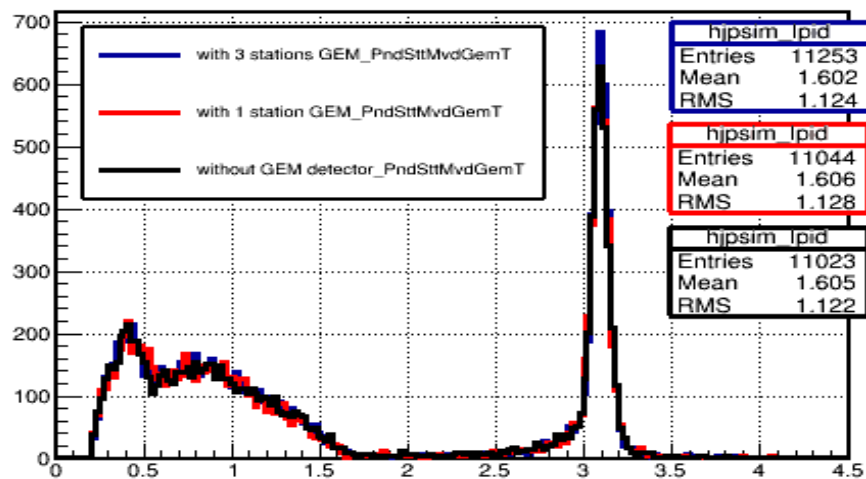- Using last GEM station improves the acceptance compared to the first GEM station.

Many Thanks For Your Attention

Comparison for three cases: NoGEM and GEM with 1 station and 3 stations - using PndSttMvdGemT
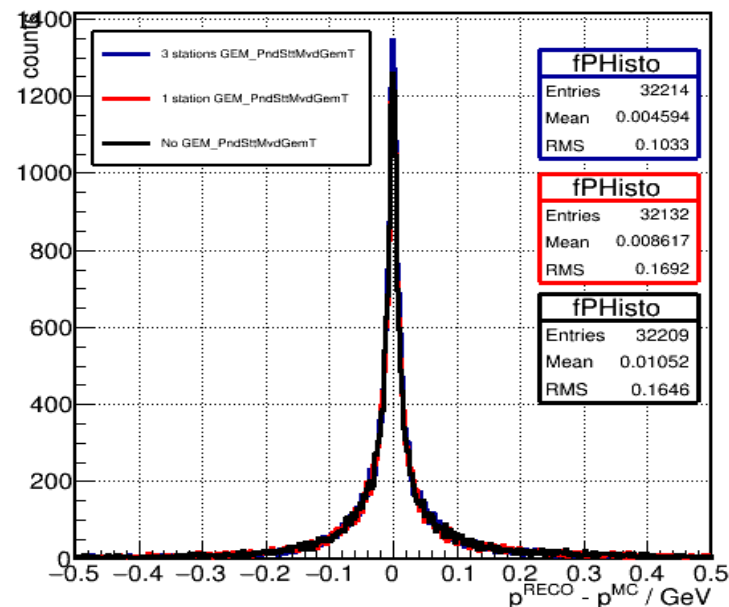
Comparison for three cases: NoGEM and GEM with 1 station and 3 stations - using PndSttMvdGemT