Mitglied der Helmholtz-Gemeinschaft

JÜLICH FORSCHUNGSZENTRUM

Zero-Width Resonances in Geant & FTF

May 04, 2017 | Albrecht Gillitzer

PANDA Hyperon eZuce Meeting

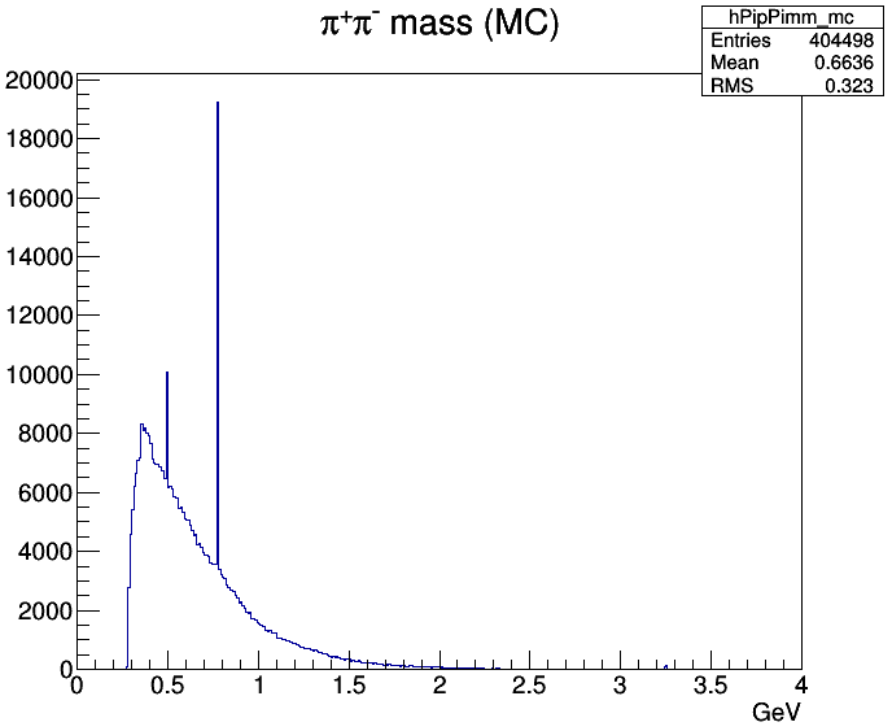
How to validate DPM & FTF simulation?

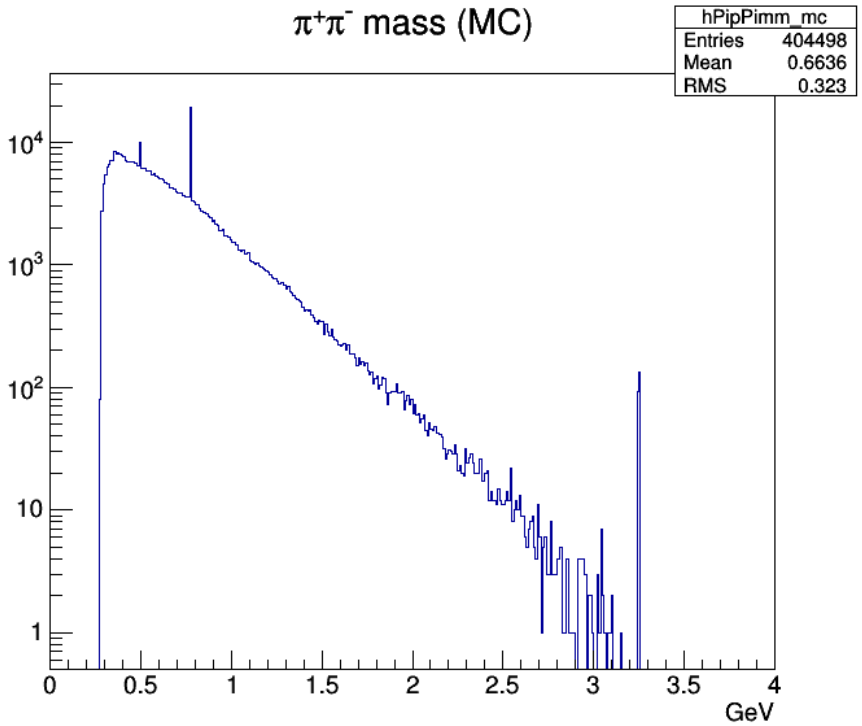
- Macros in …/macro/qa/dpm4 (and …/dpm3)
- Found that macros are useless since they attempt to reconstruct J/ψ and ψ(2S)
- Which are the appropriate criteria?
- Idea: try to reconstruct composite particles:

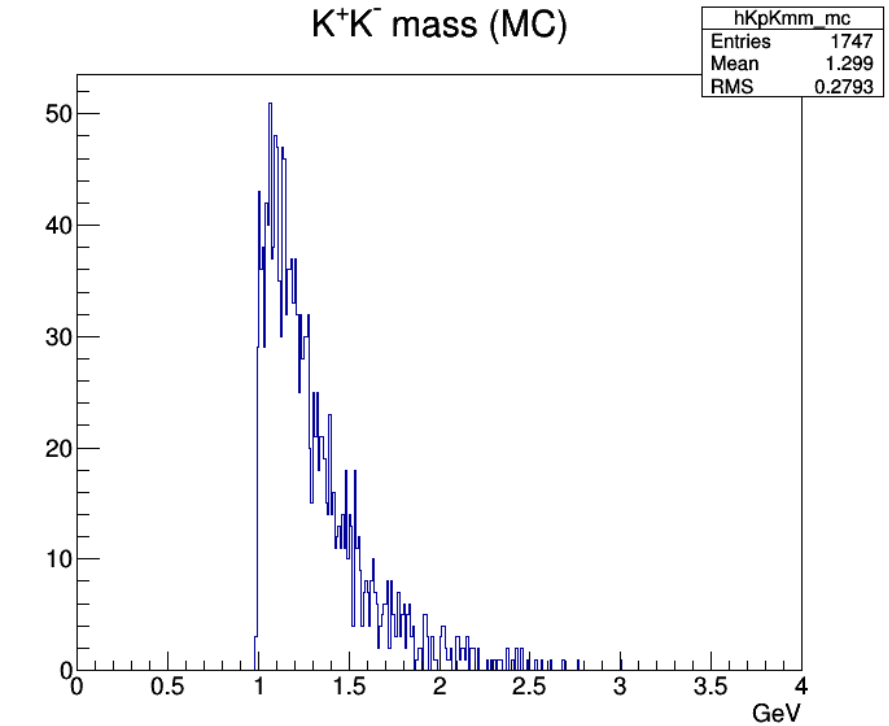
10^5 DPM events

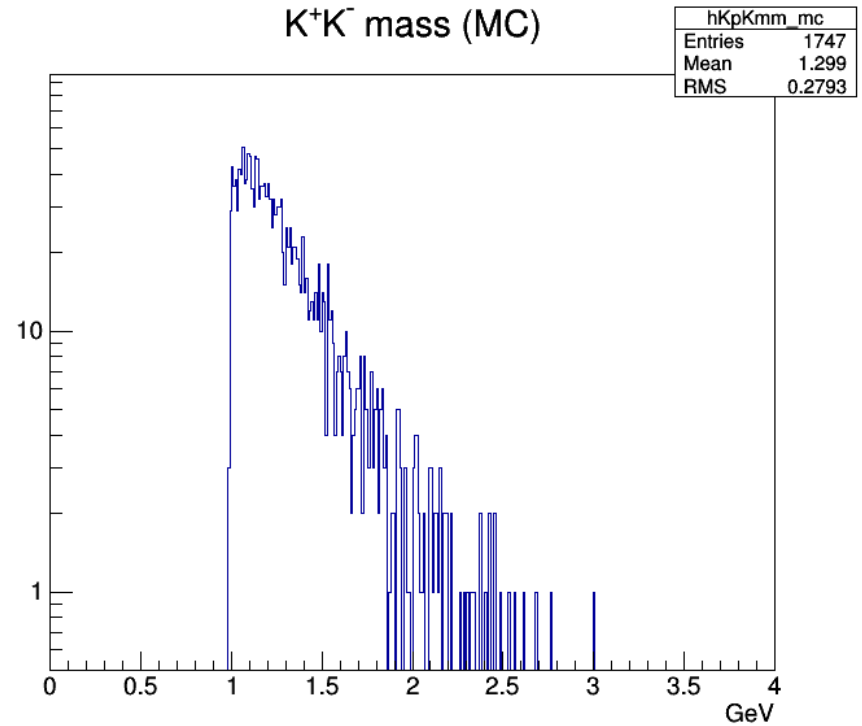
MC Truth primary & secondary particles

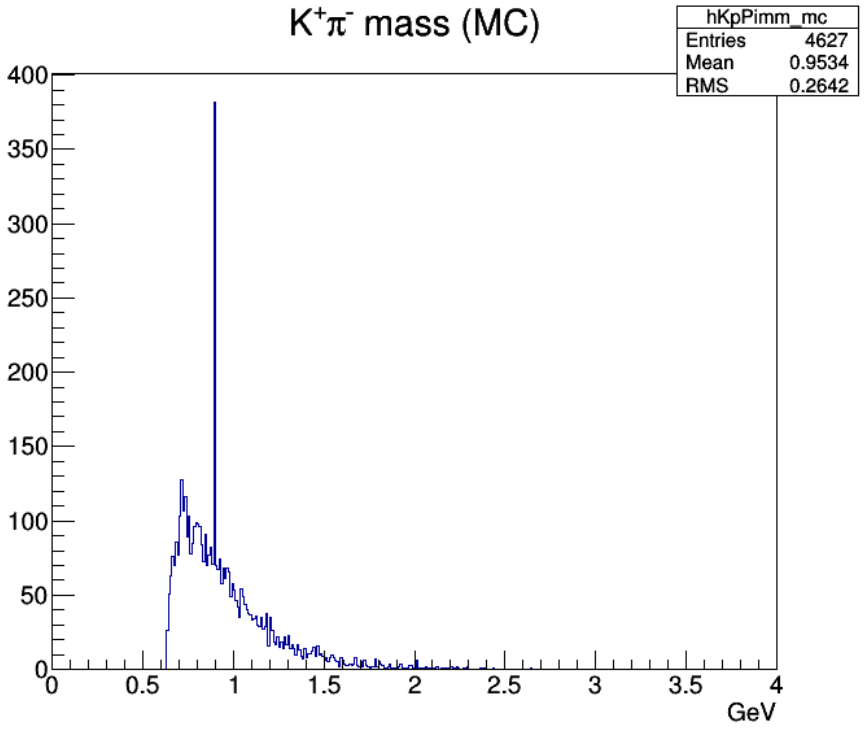
Combination of two particles coming from same vertex

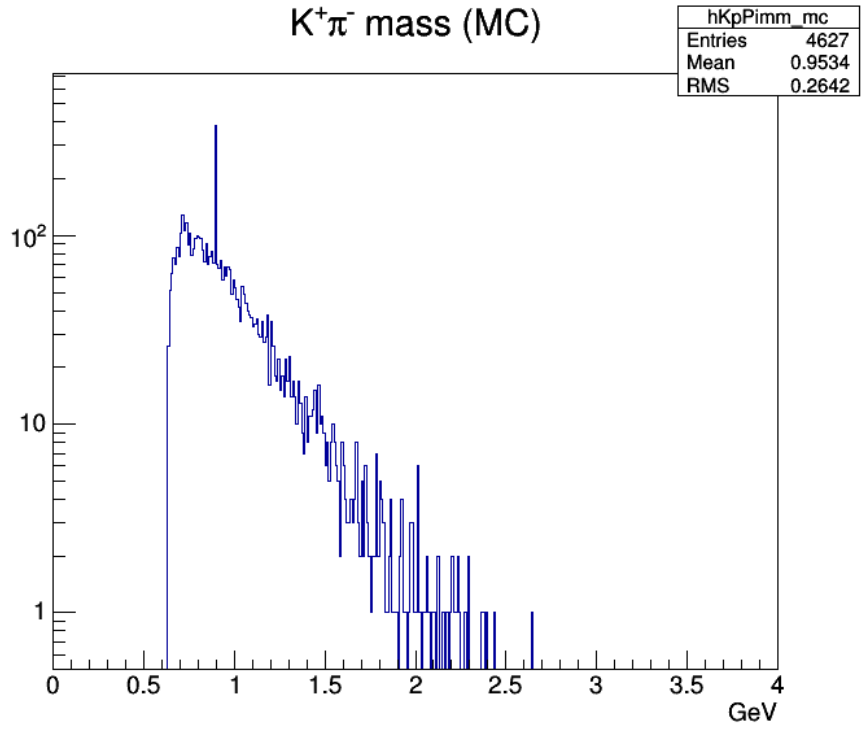


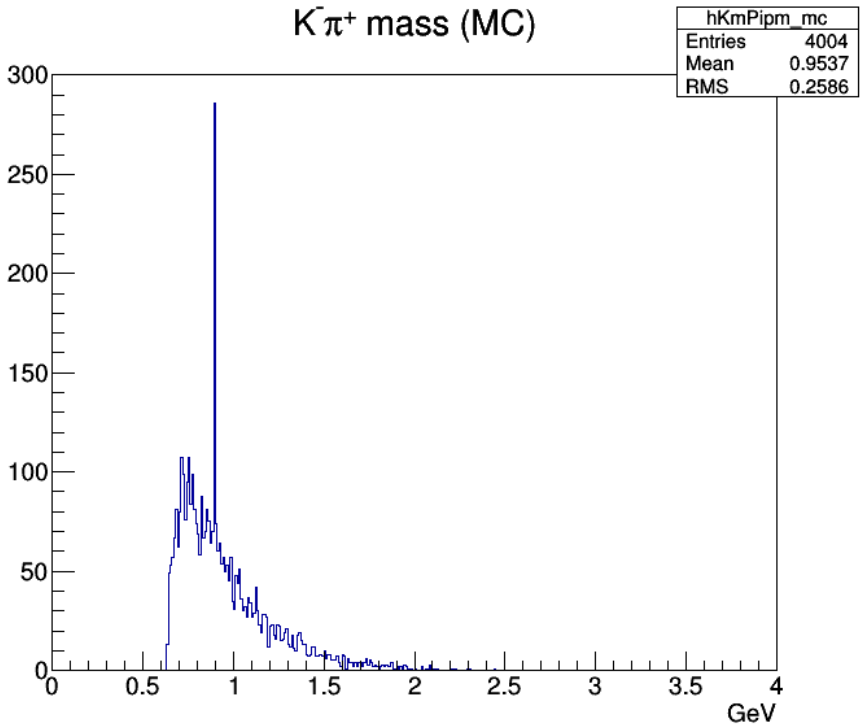


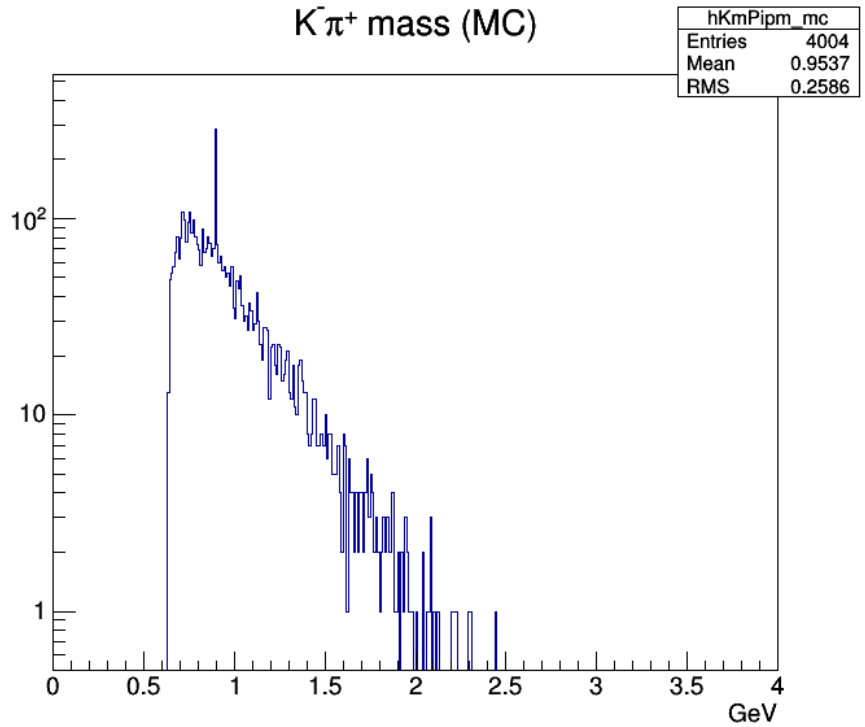


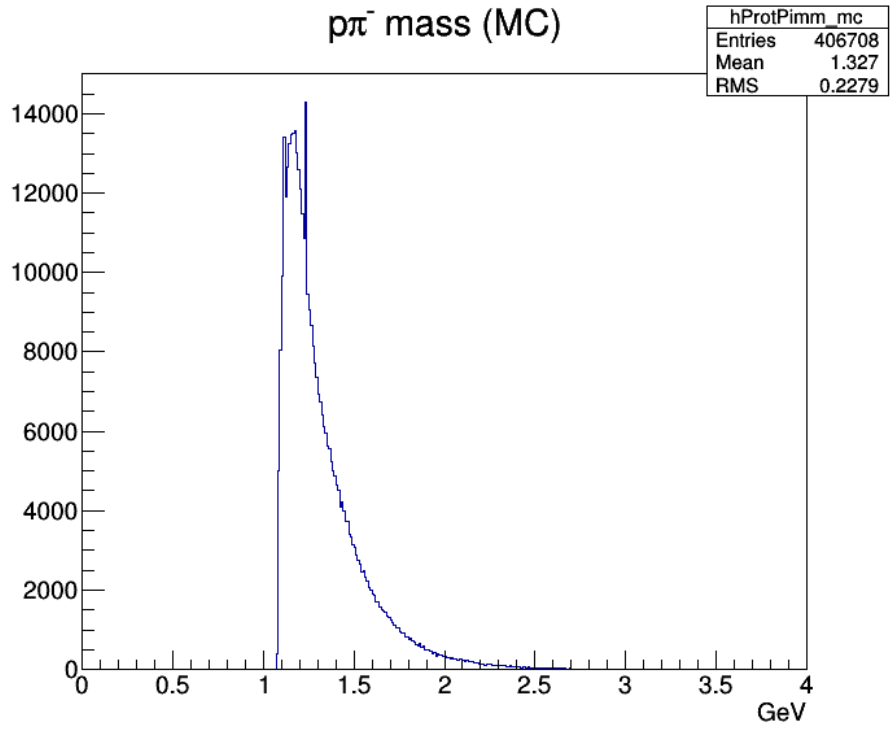


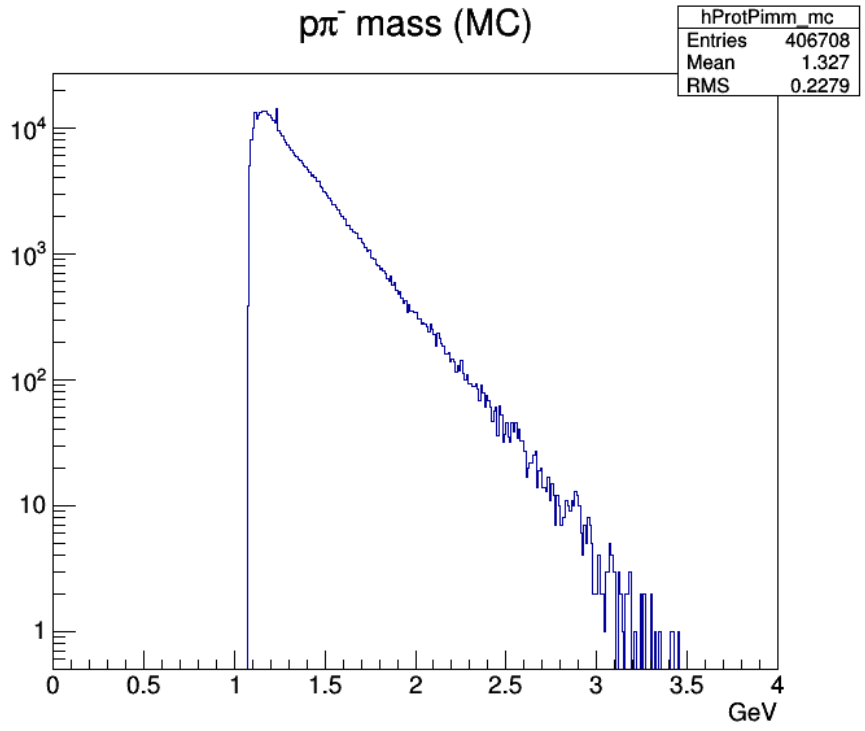

K+π- mass (MC)
hKpPimm_mc
Entries 4627
Mean 0.9534
RMS 0.2642
GeV

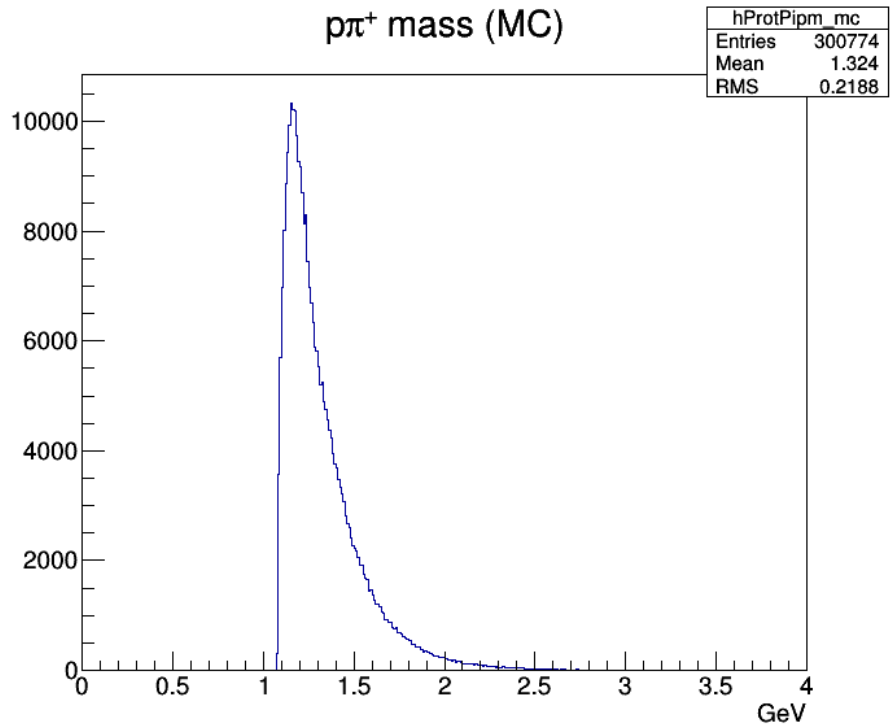

K+π- mass (MC)
hKpPimm_mc
Entries 4627
Mean 0.9534
RMS 0.2642
GeV

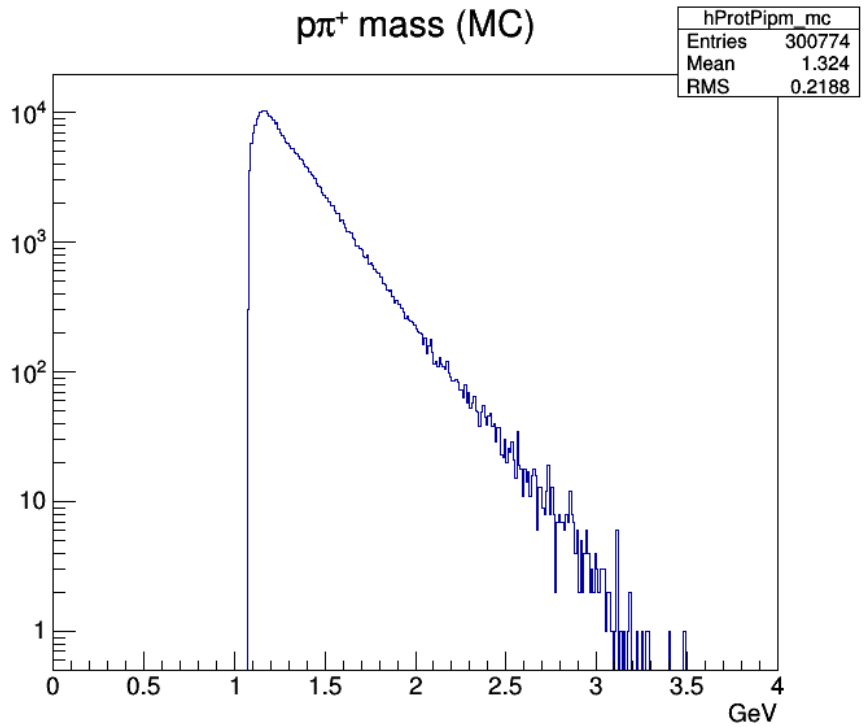

K-π+ mass (MC)
hKmPipm_mc
Entries 4004
Mean 0.9537
RMS 0.2586
GeV


K-π+ mass (MC)
hKmPipm_mc
Entries 4004
Mean 0.9537
RMS 0.2586
GeV


pπ⁻ mass (MC)
hProtPimm_mc
Entries 406708
Mean 1.327
RMS 0.2279
GeV


pπ⁻ mass (MC)
hProtPimm_mc
Entries 406708
Mean 1.327
RMS 0.2279
GeV


pπ⁺ mass (MC)
hProtPipm_mc
Entries 300774
Mean 1.324
RMS 0.2188
GeV


pπ⁺ mass (MC)
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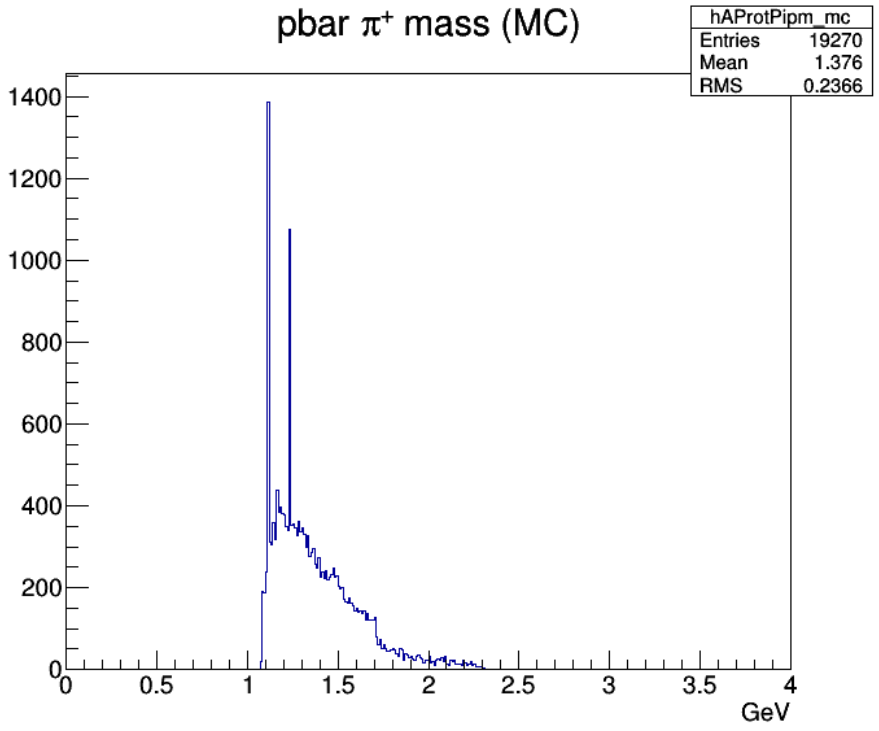
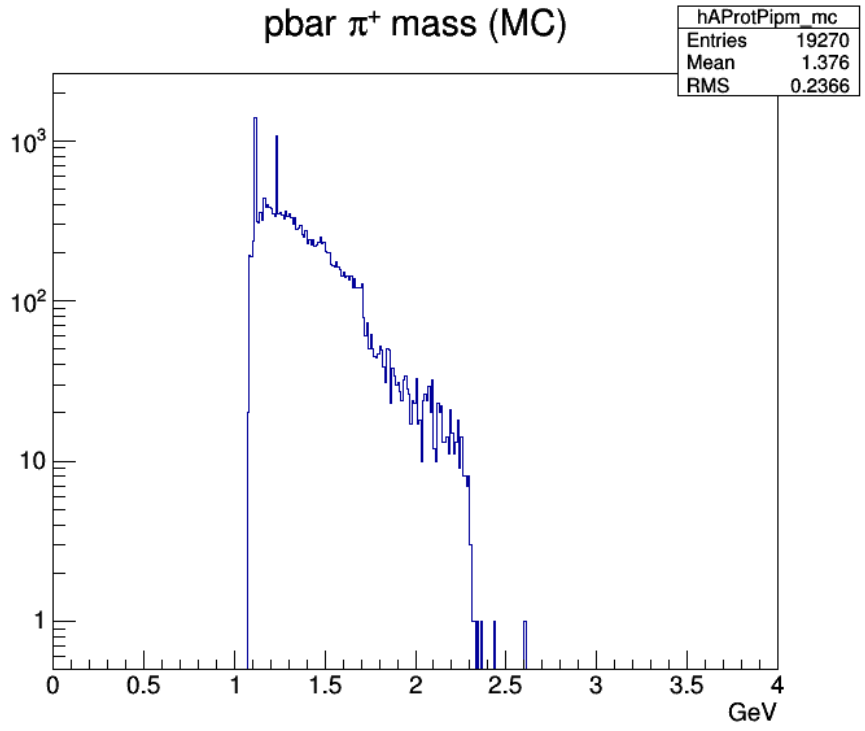
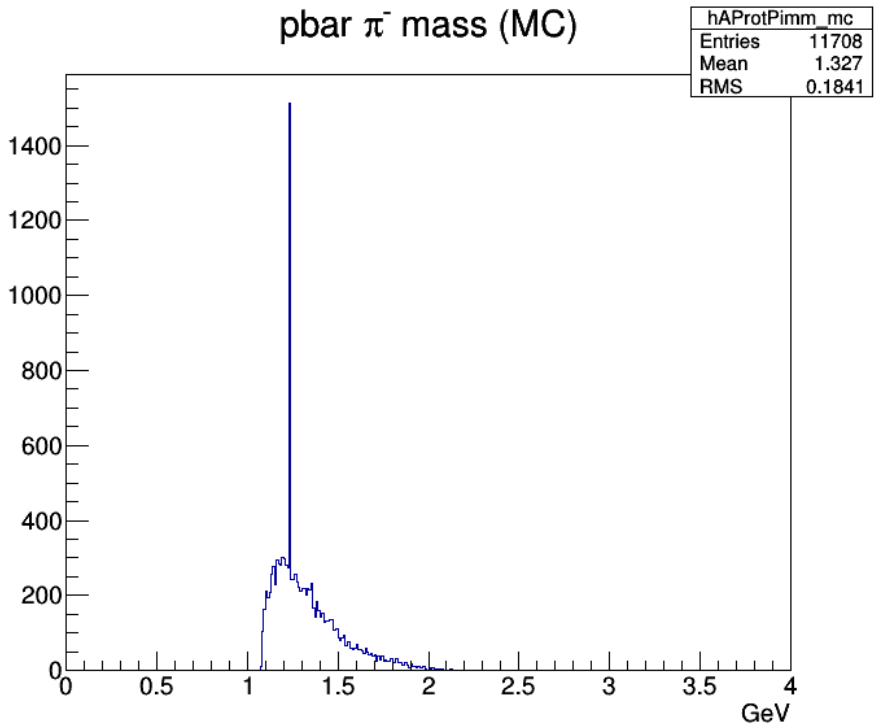
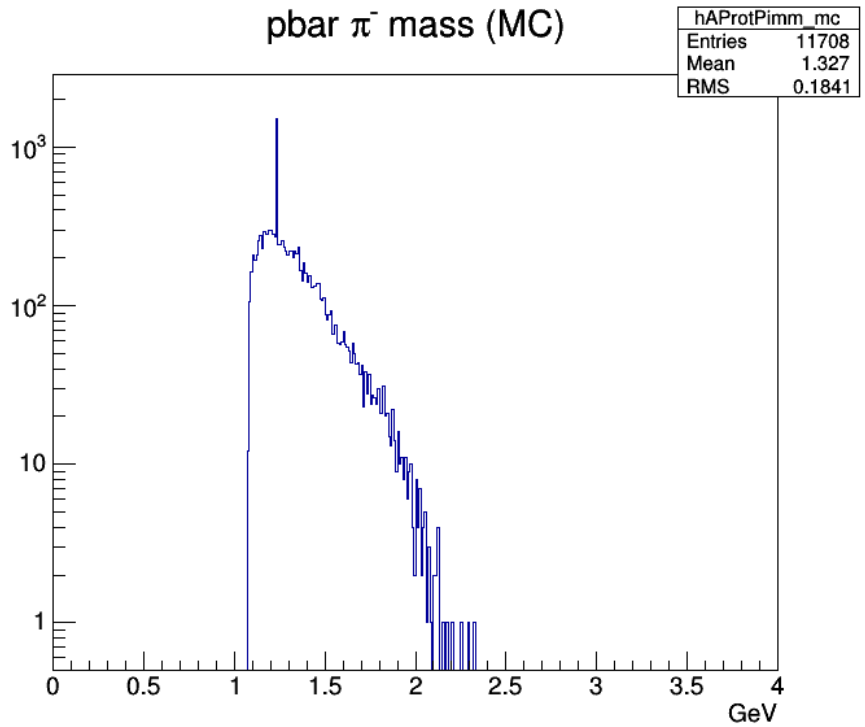
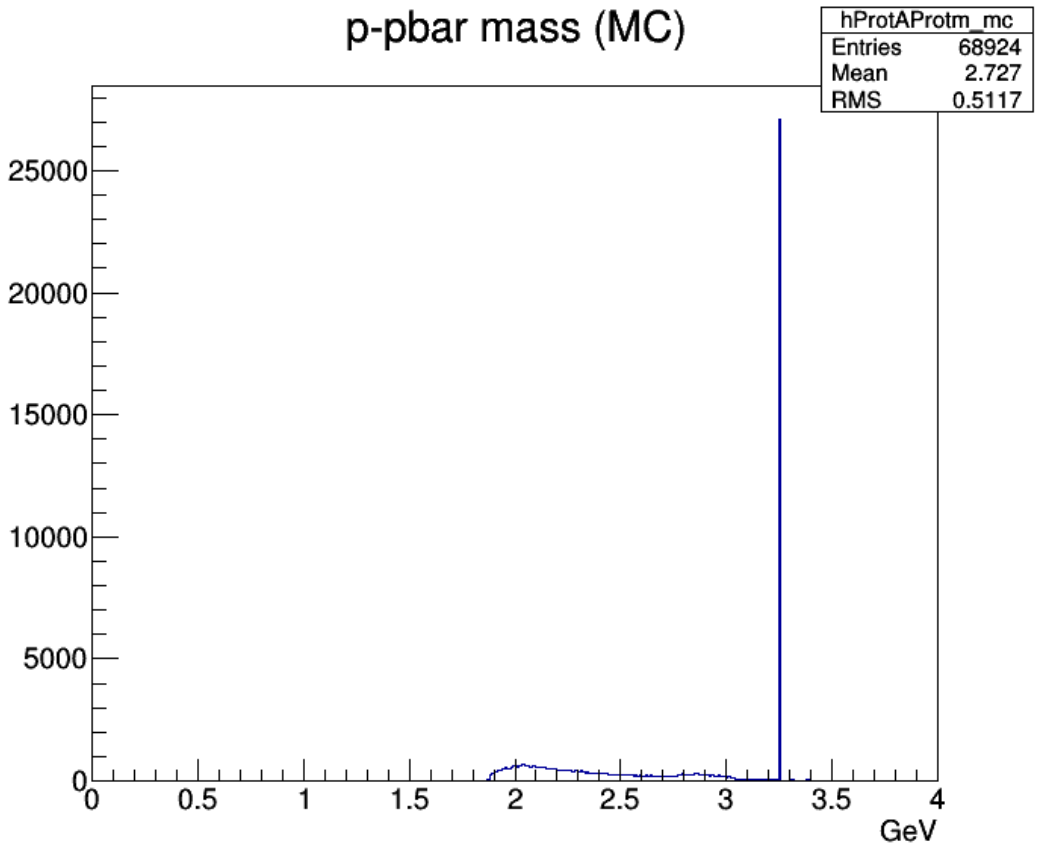
Entries 300774
Mean 1.324
RMS 0.2188
GeV


pbar π⁺ mass (MC)
hAProtPipm_mc
Entries 19270
Mean 1.376
RMS 0.2366
GeV


pbar π⁺ mass (MC)
hAProtPipm_mc
Entries 19270
Mean 1.376
RMS 0.2366
GeV


pbar π⁻ mass (MC)
hAProtPimm_mc
Entries 11708
Mean 1.327
RMS 0.1841
GeV


pbar π⁻ mass (MC)
hAProtPimm_mc
Entries 11708
Mean 1.327
RMS 0.1841
GeV


p-pbar mass (MC)
hProtAProtm_mc
Entries 68924
Mean 2.727
RMS 0.5117
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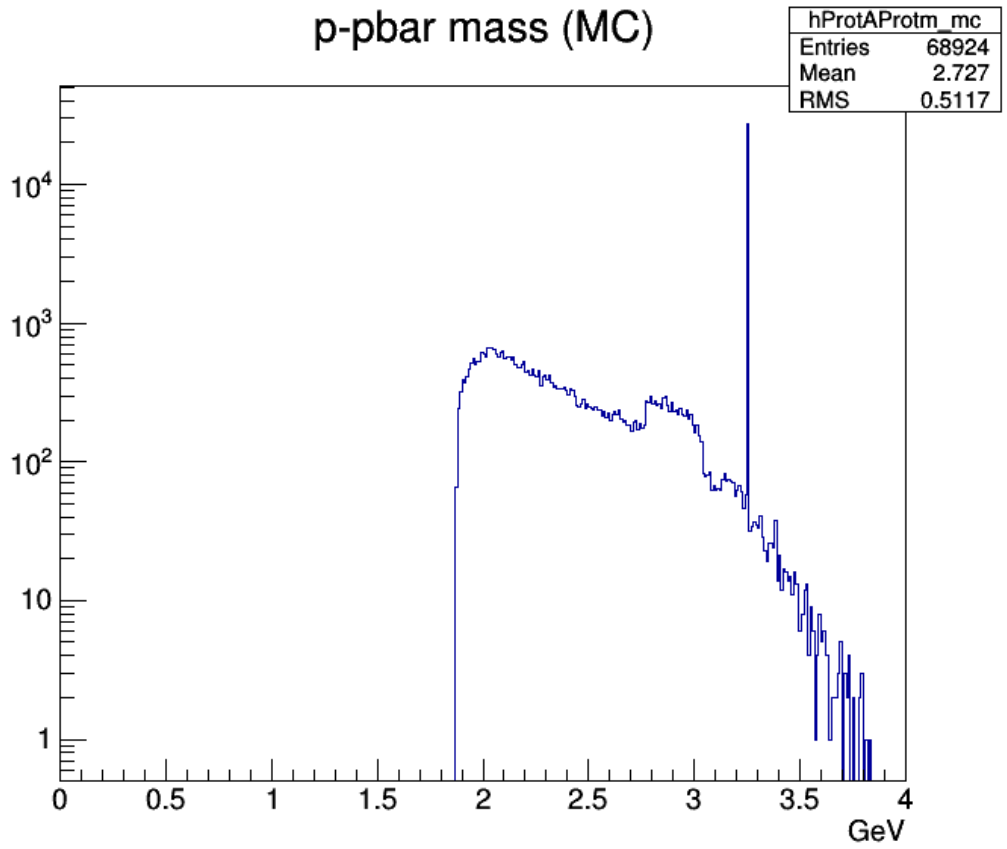
20000
15000
10000
5000
0
0
0.5
1
1.5
2
2.5
3
3.5
4
GeV


p-pbar mass (MC)
hProtAProtm_mc
Entries 68924
Mean 2.727
RMS 0.5117
10^4
10^3
10^2
10
1
0
0.5
1
1.5
2
2.5
3
3.5
4
GeV

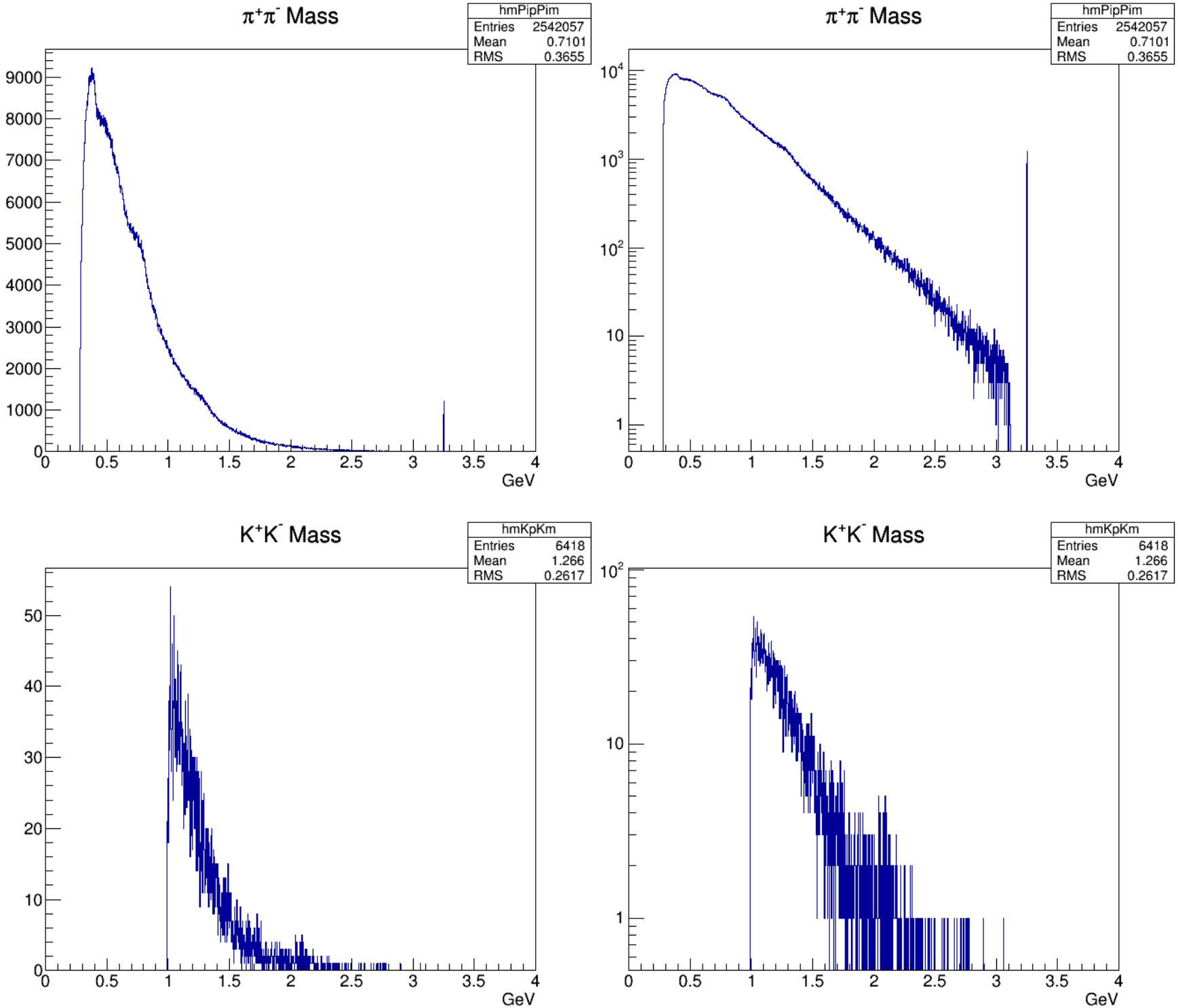
Direct Test of DPM and FTF Generator Output

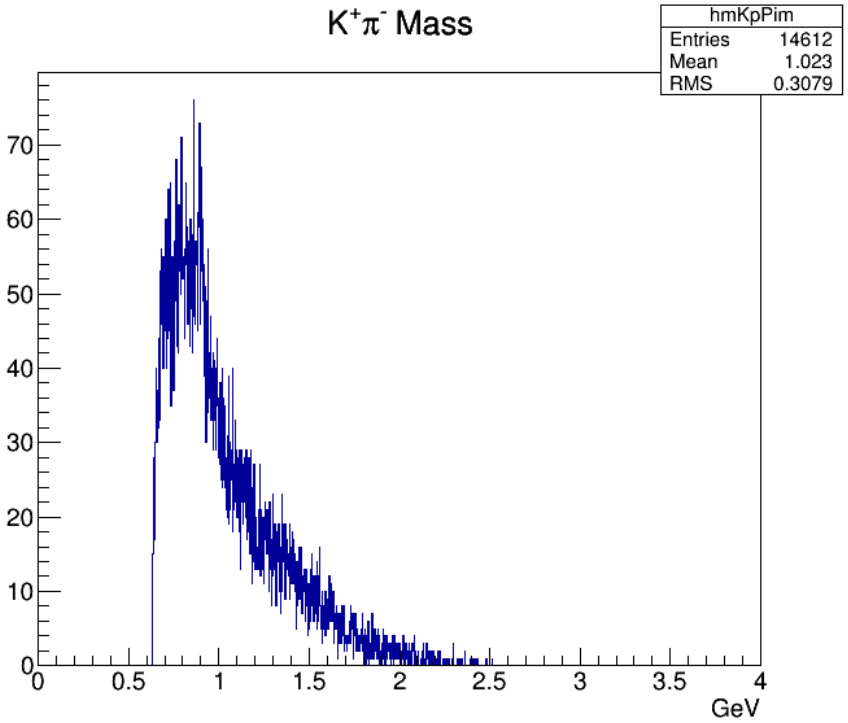
- 1.0 M events
- 4.6 GeV/c
- Generator output

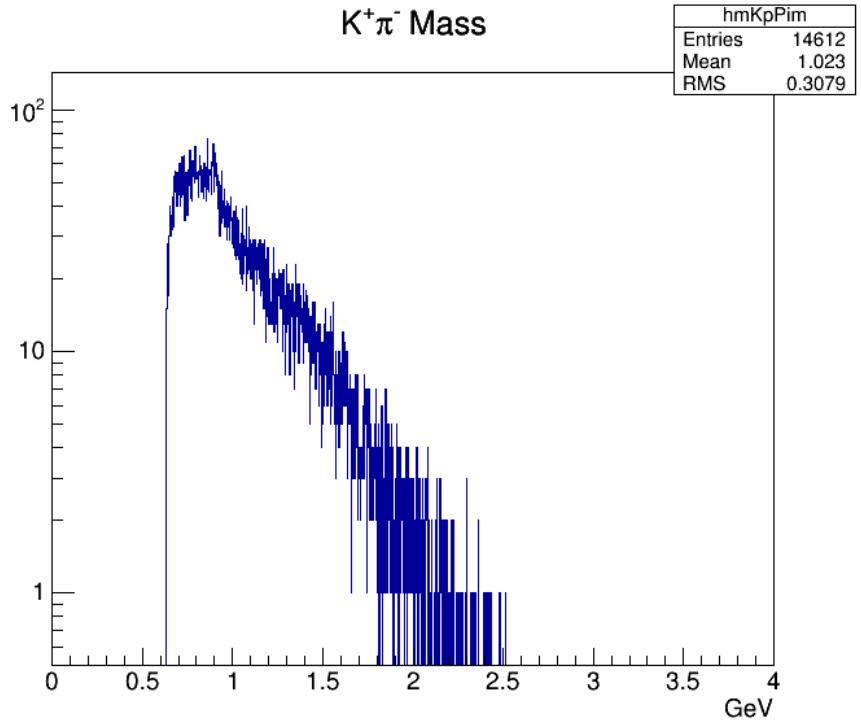
10^6 DPM events

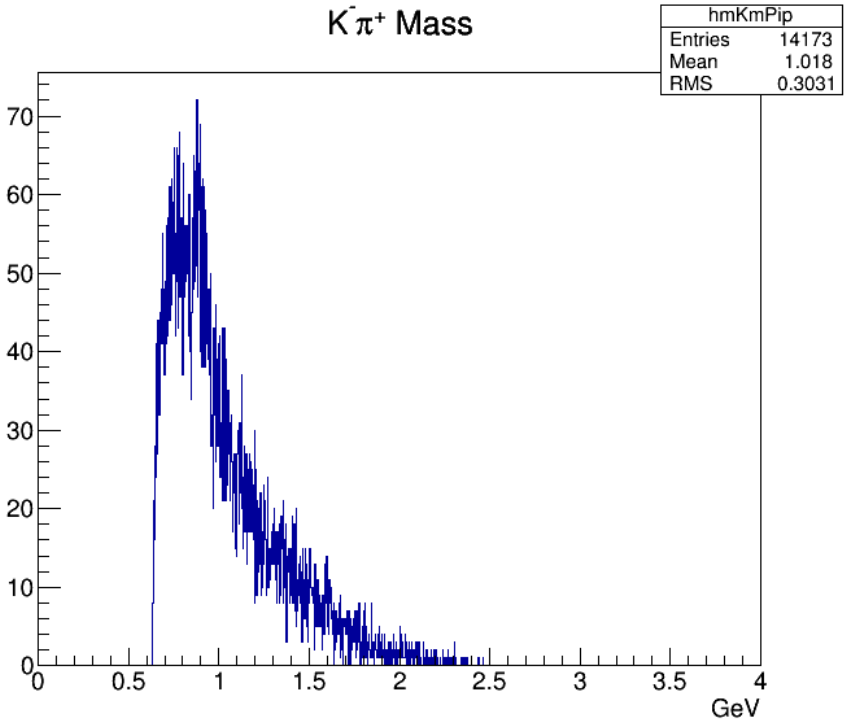
MC generated primary particles

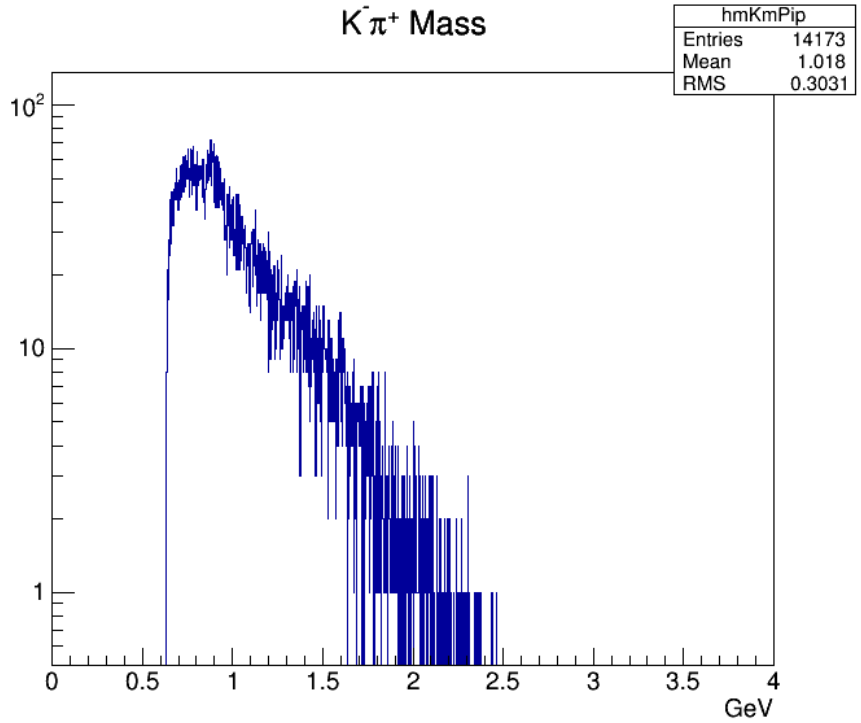
Combination of two particles

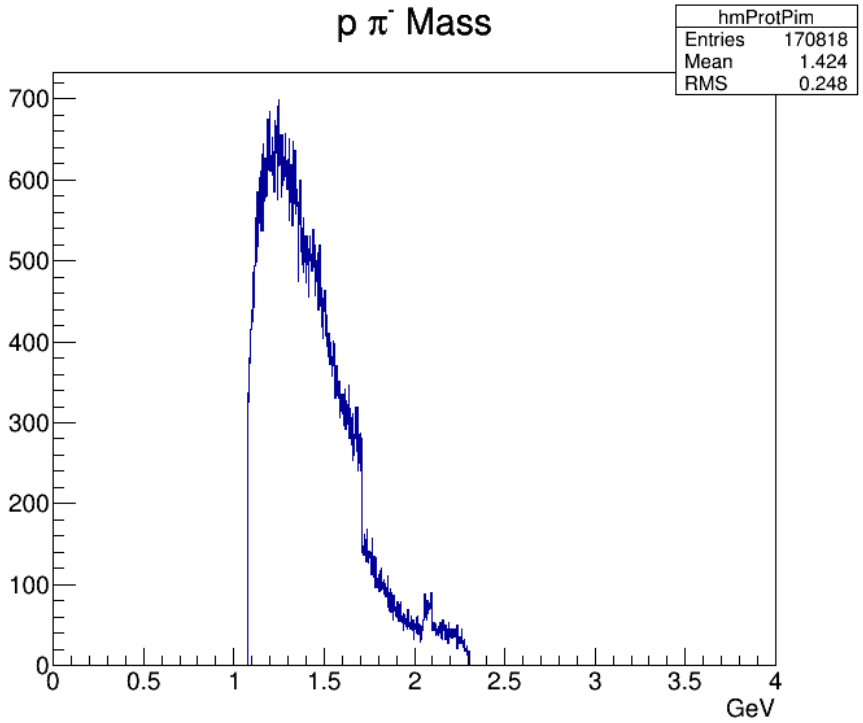


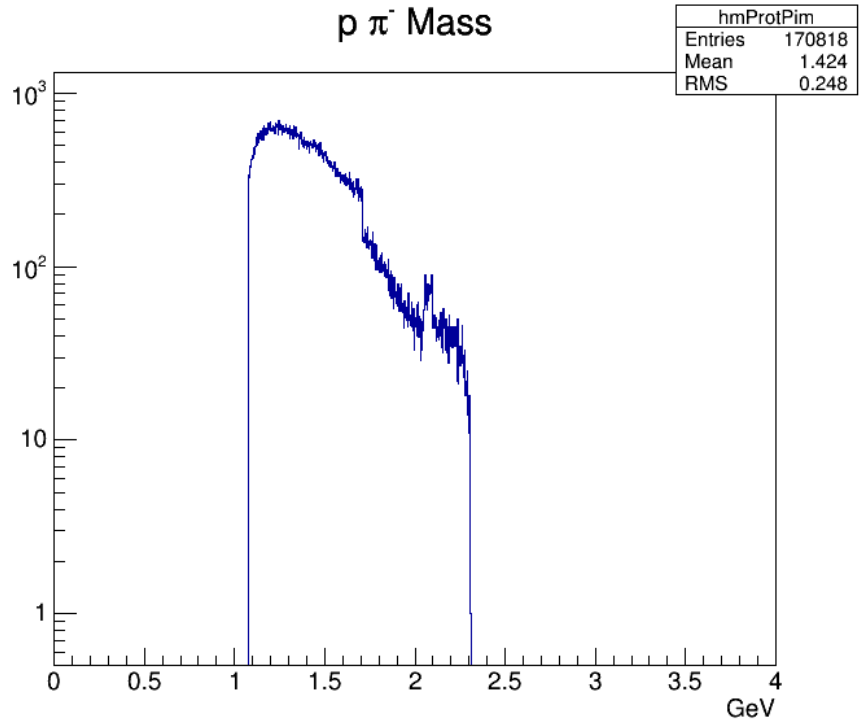

K+π- Mass
hmKpPim
Entries 14612
Mean 1.023
RMS 0.3079
GeV

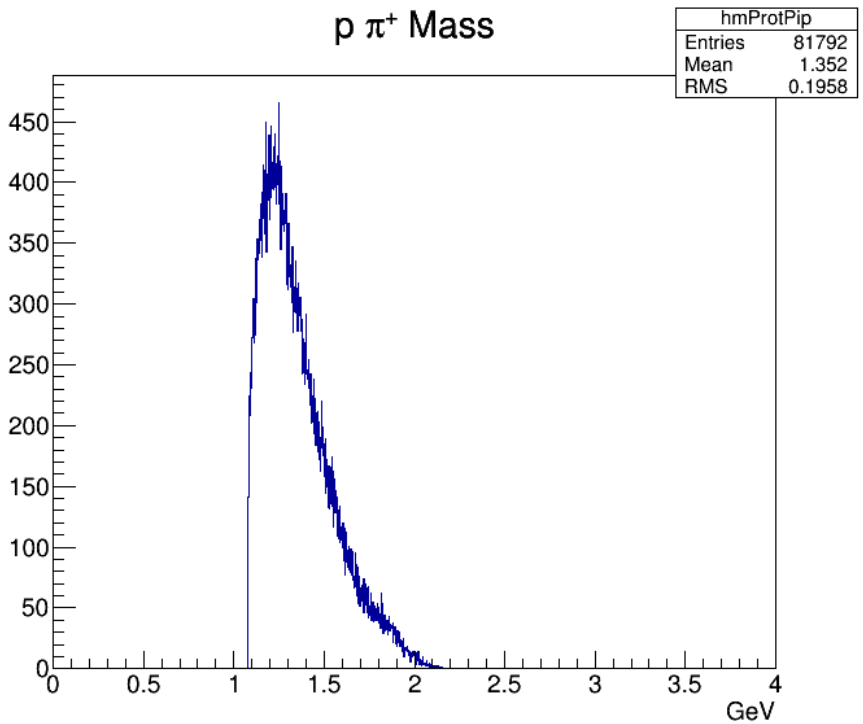

K+π- Mass
hmKpPim
Entries 14612
Mean 1.023
RMS 0.3079
GeV


K-π+ Mass
hmKmPip
Entries 14173
Mean 1.018
RMS 0.3031
GeV


K-π+ Mass
hmKmPip
Entries 14173
Mean 1.018
RMS 0.3031
GeV


p π⁻ Mass
hmProtPim
Entries 170818
Mean 1.424
RMS 0.248
GeV


p π⁻ Mass
hmProtPim
Entries 170818
Mean 1.424
RMS 0.248
GeV


p π⁺ Mass
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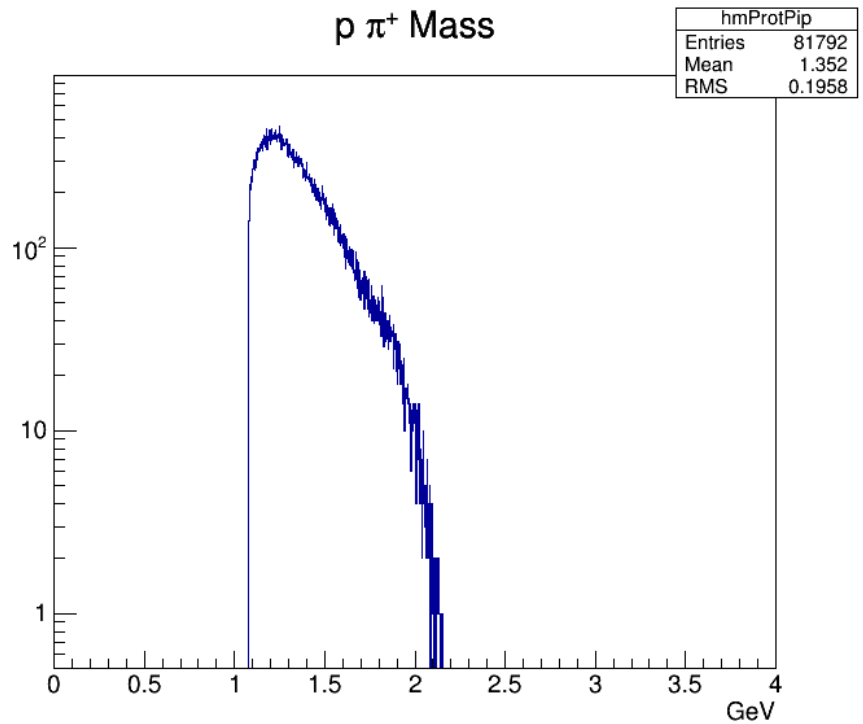
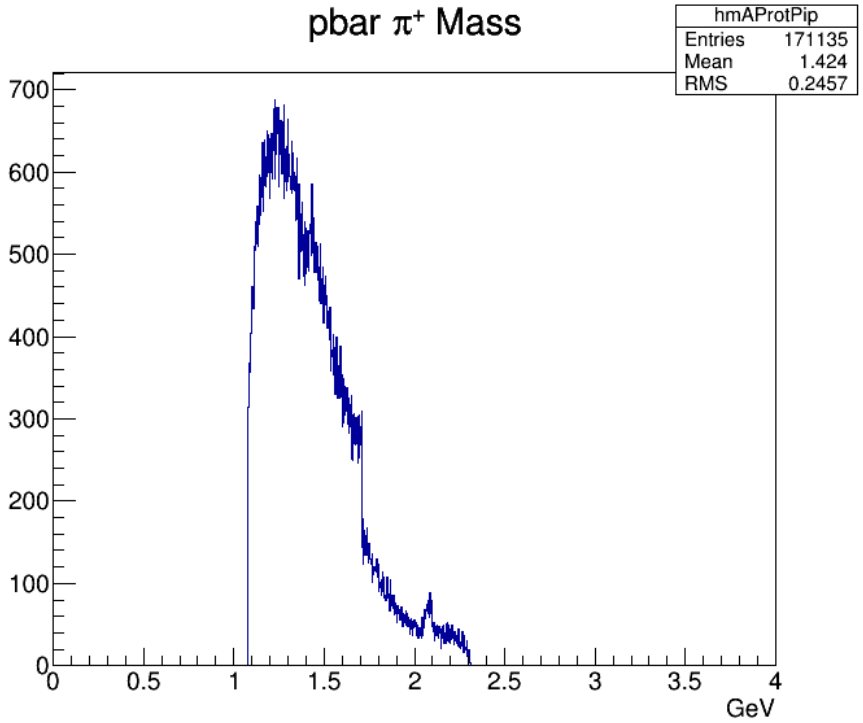
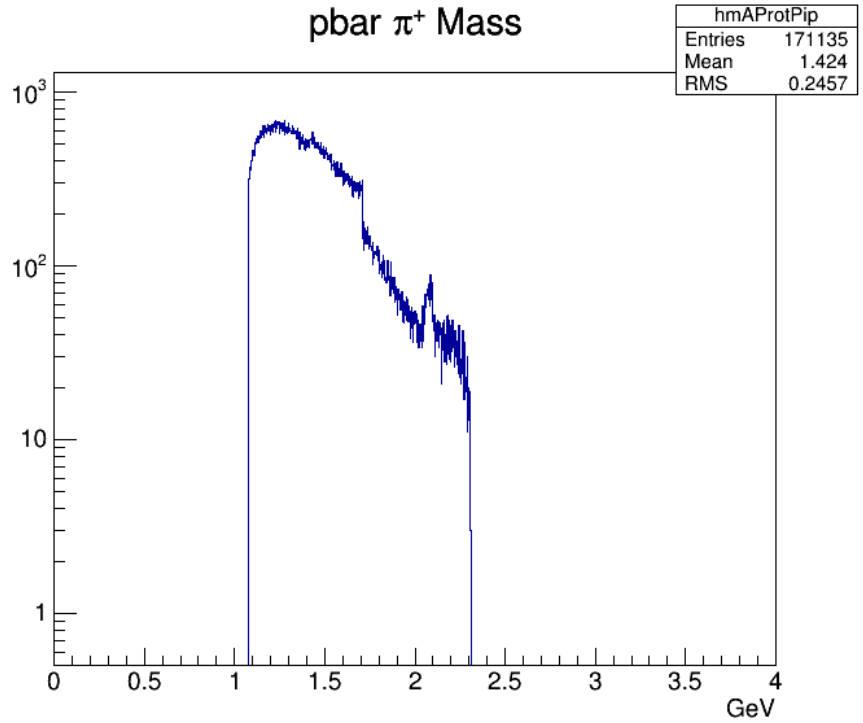
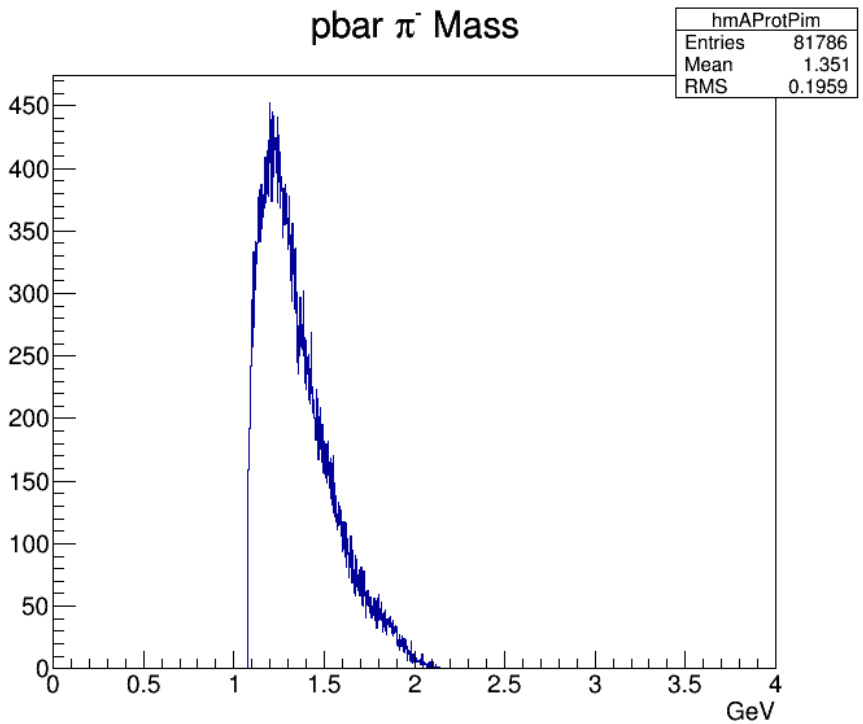
Entries 81792
Mean 1.352
RMS 0.1958
GeV


p π⁺ Mass
hmProtPip
Entries 81792
Mean 1.352
RMS 0.1958
GeV


pbar π⁺ Mass
hmAProtPip
Entries 171135
Mean 1.424
RMS 0.2457
GeV


pbar π⁺ Mass
hmAProtPip
Entries 171135
Mean 1.424
RMS 0.2457
GeV


pbar π⁻ Mass
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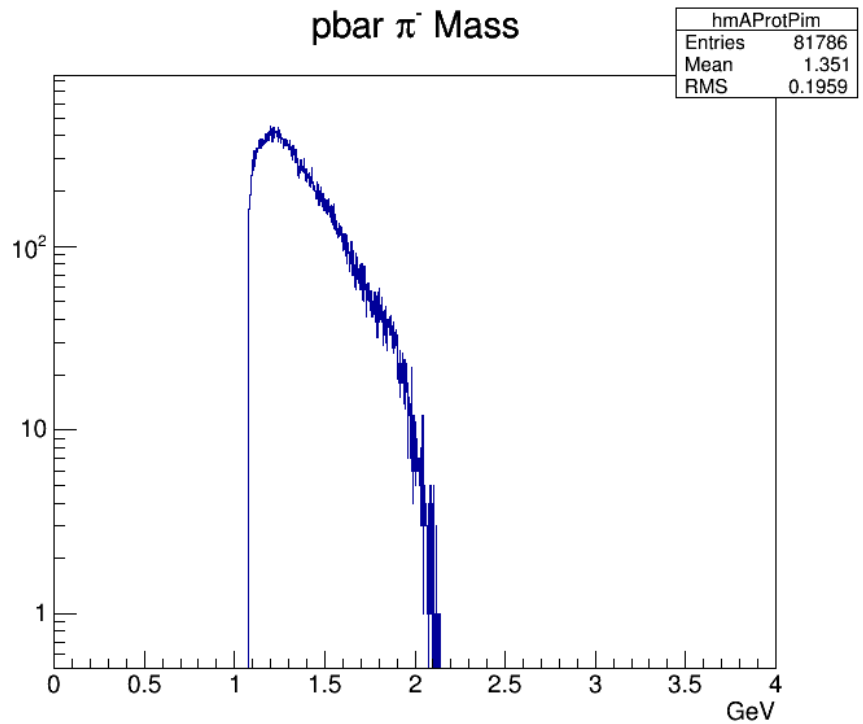
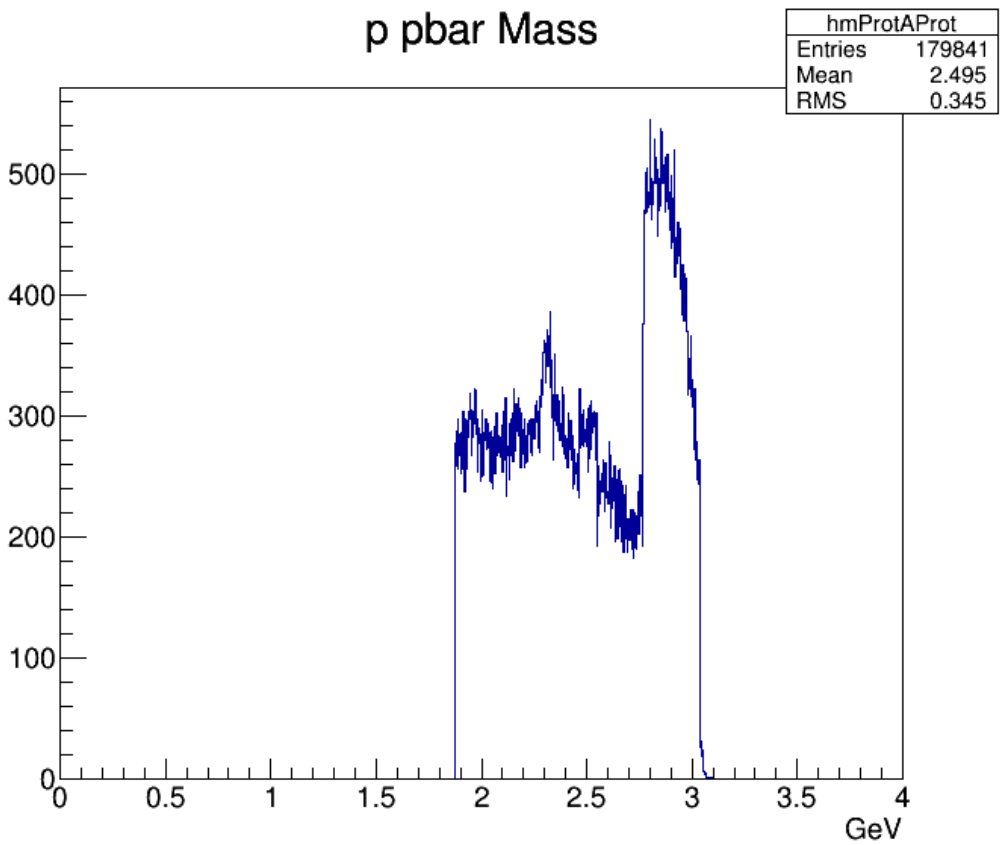
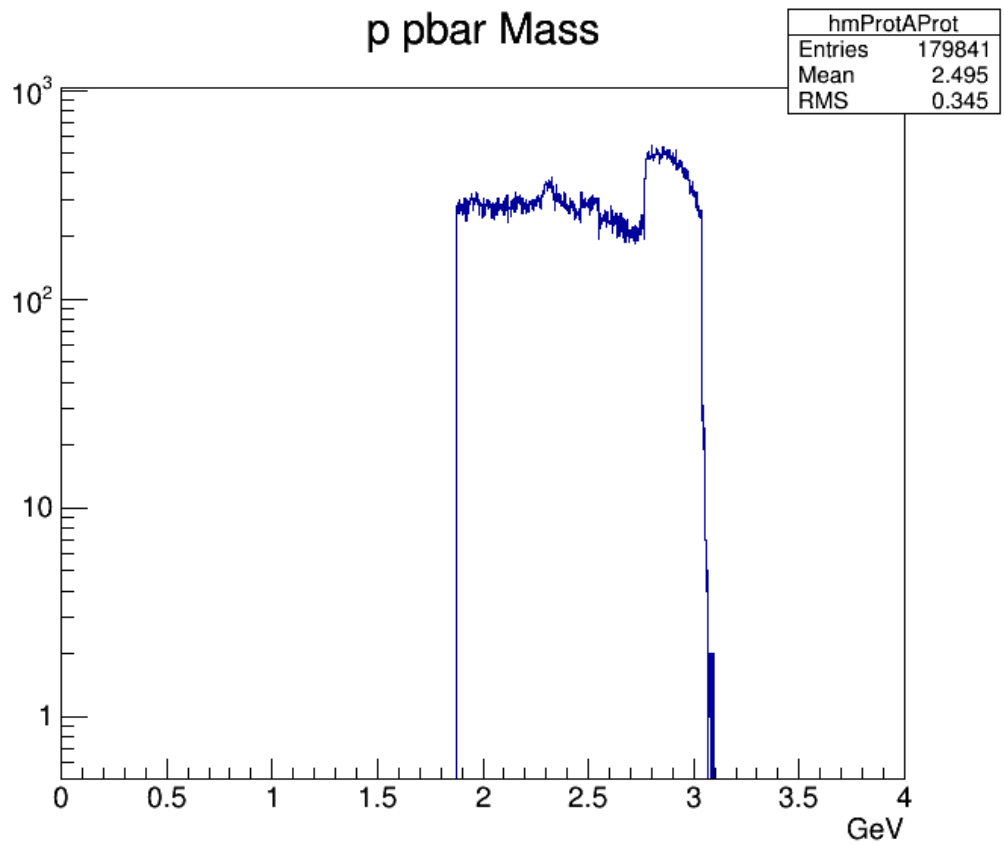
Entries 81786
Mean 1.351
RMS 0.1959
GeV


pbar π⁻ Mass
hmAProtPim
Entries 81786
Mean 1.351
RMS 0.1959
GeV



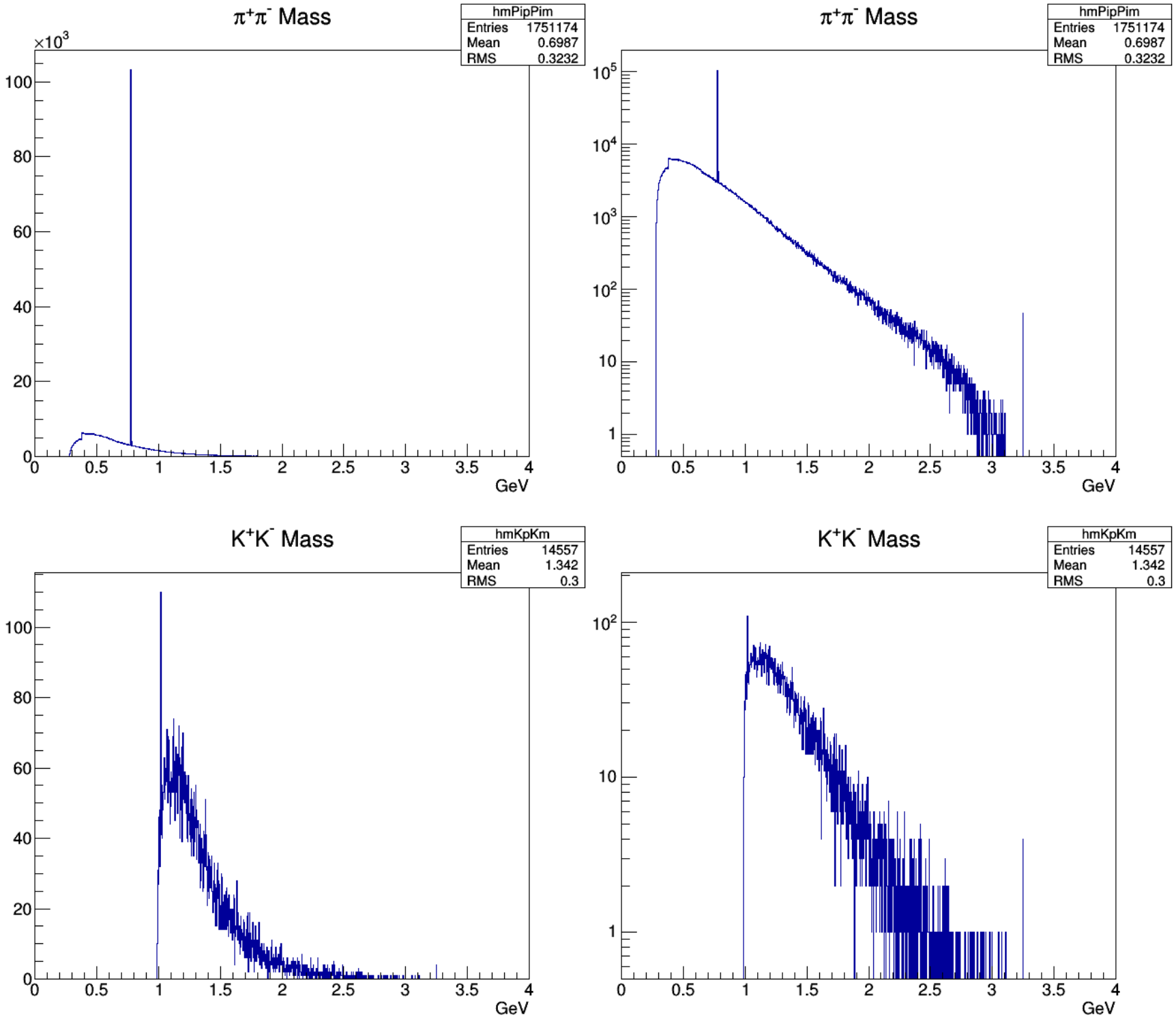


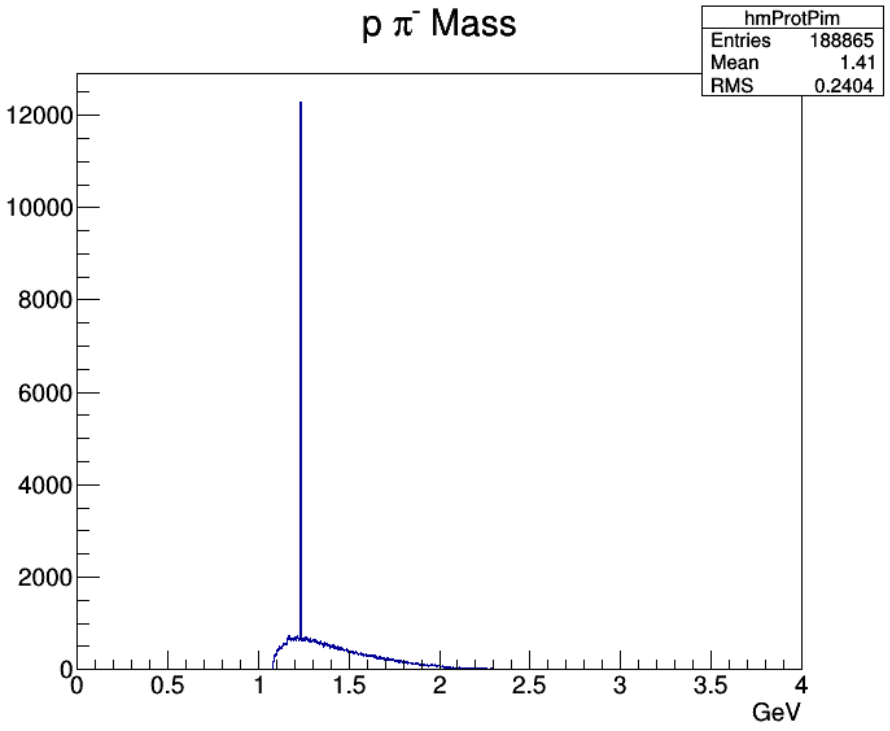
Used „no elastic“ option: no $\bar{p}p$ elastic peak

10^6 FTF events

MC generated primary particles

Combination of two particles




p π⁻ Mass
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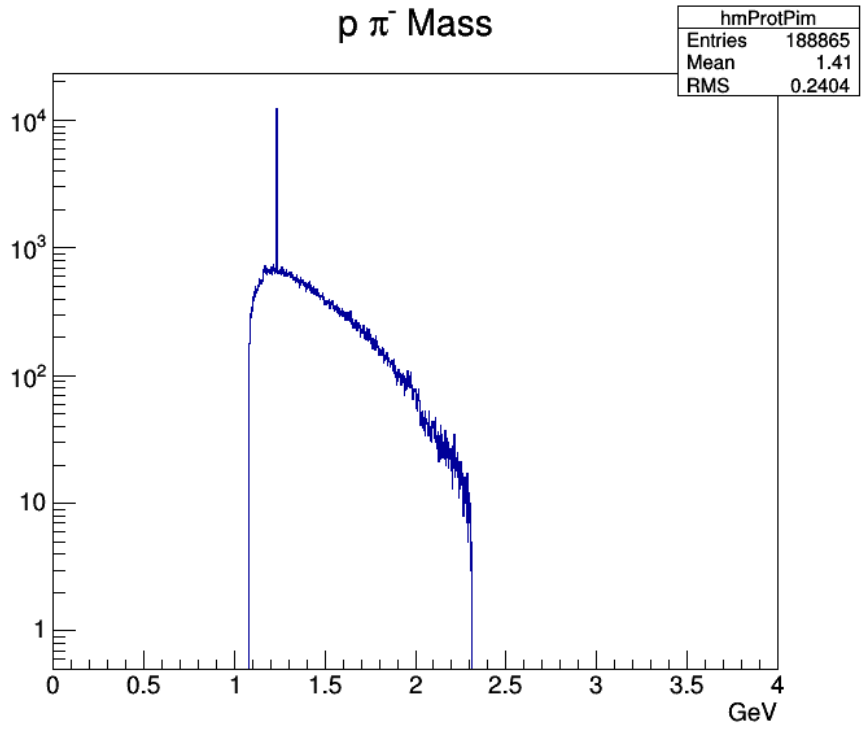
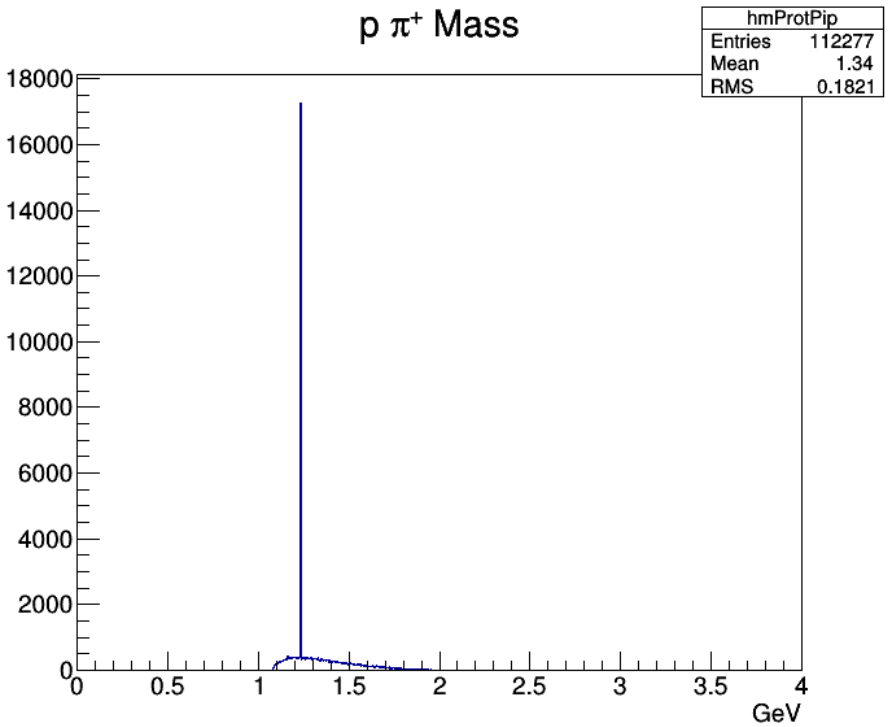
Entries 188865
Mean 1.41
RMS 0.2404
GeV


p π⁻ Mass
hmProtPim
Entries 188865
Mean 1.41
RMS 0.2404
GeV


p π⁺ Mass
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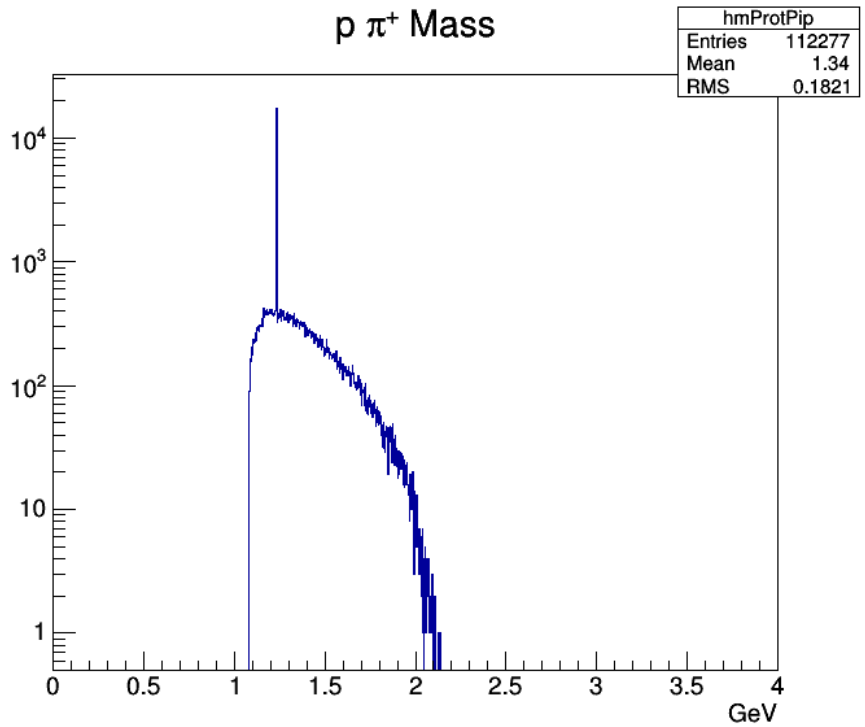
Entries 112277
Mean 1.34
RMS 0.1821
GeV


p π⁺ Mass
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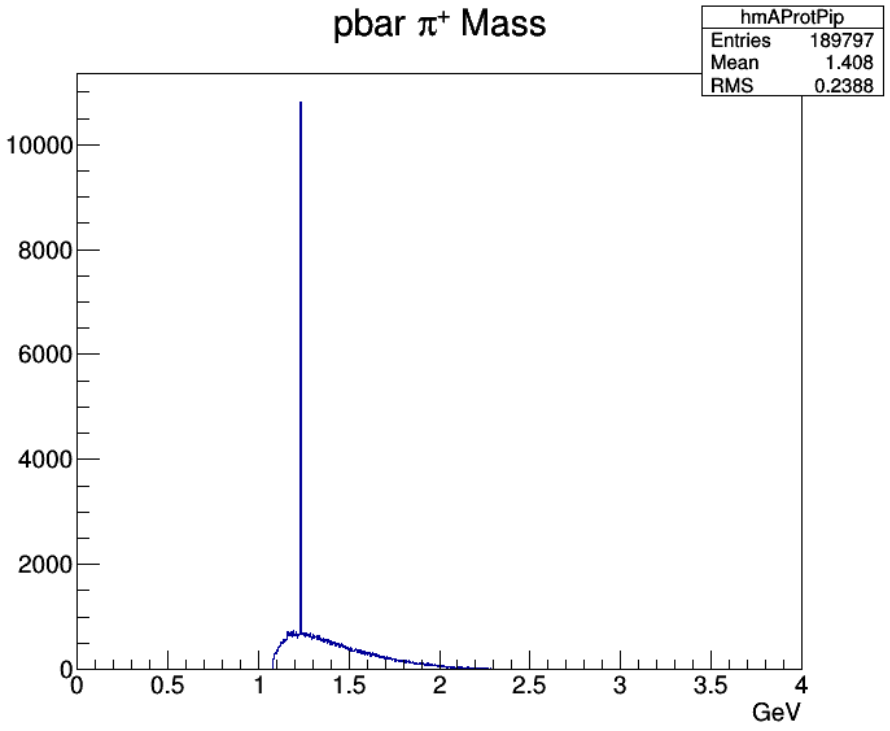
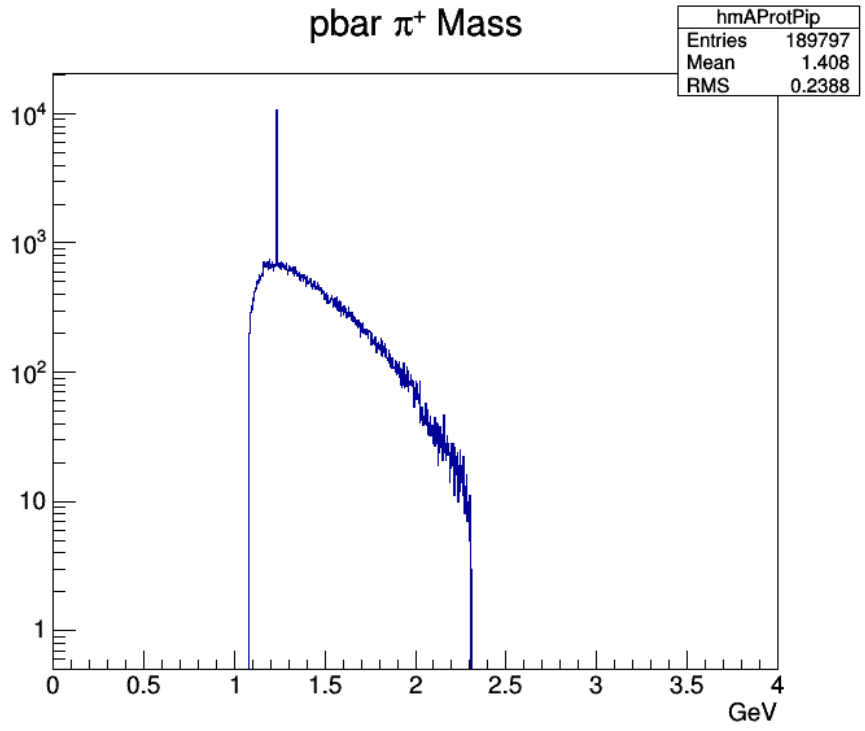
Entries 112277
Mean 1.34
RMS 0.1821
GeV


pbar π+ Mass
hmAProtPip
Entries 189797
Mean 1.408
RMS 0.2388
GeV


pbar π+ Mass
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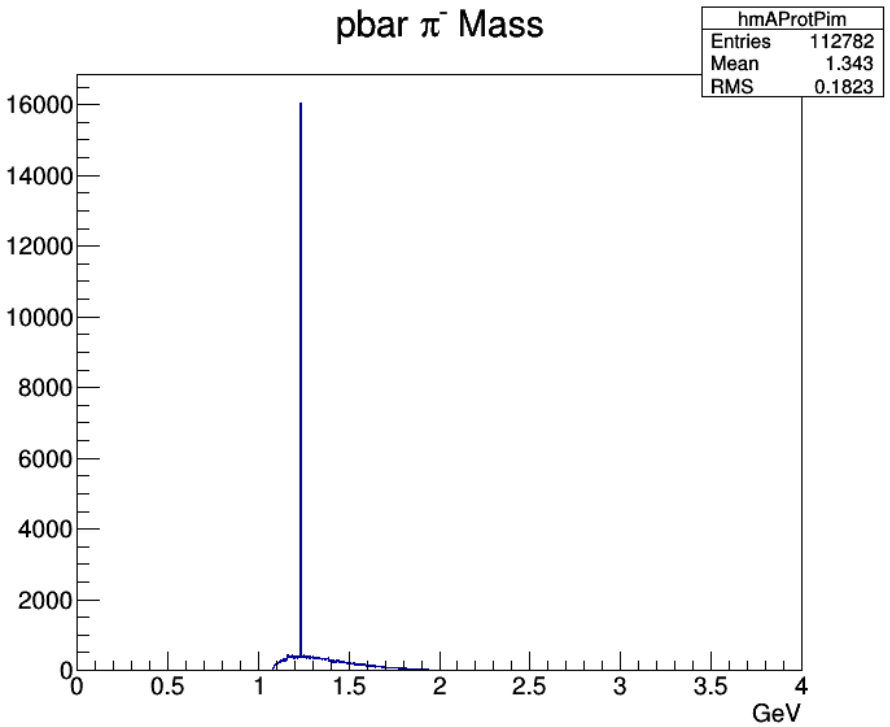
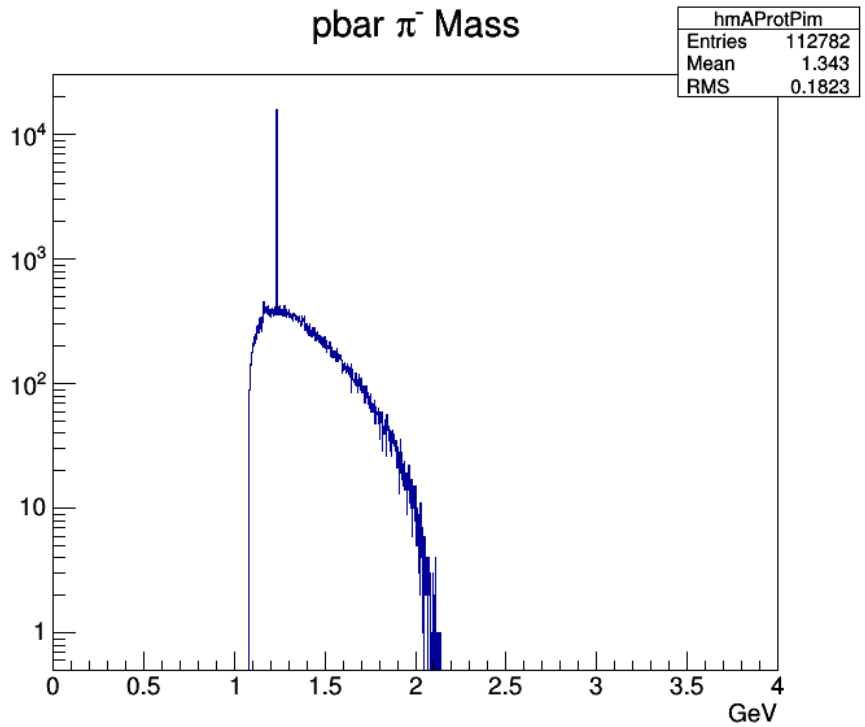
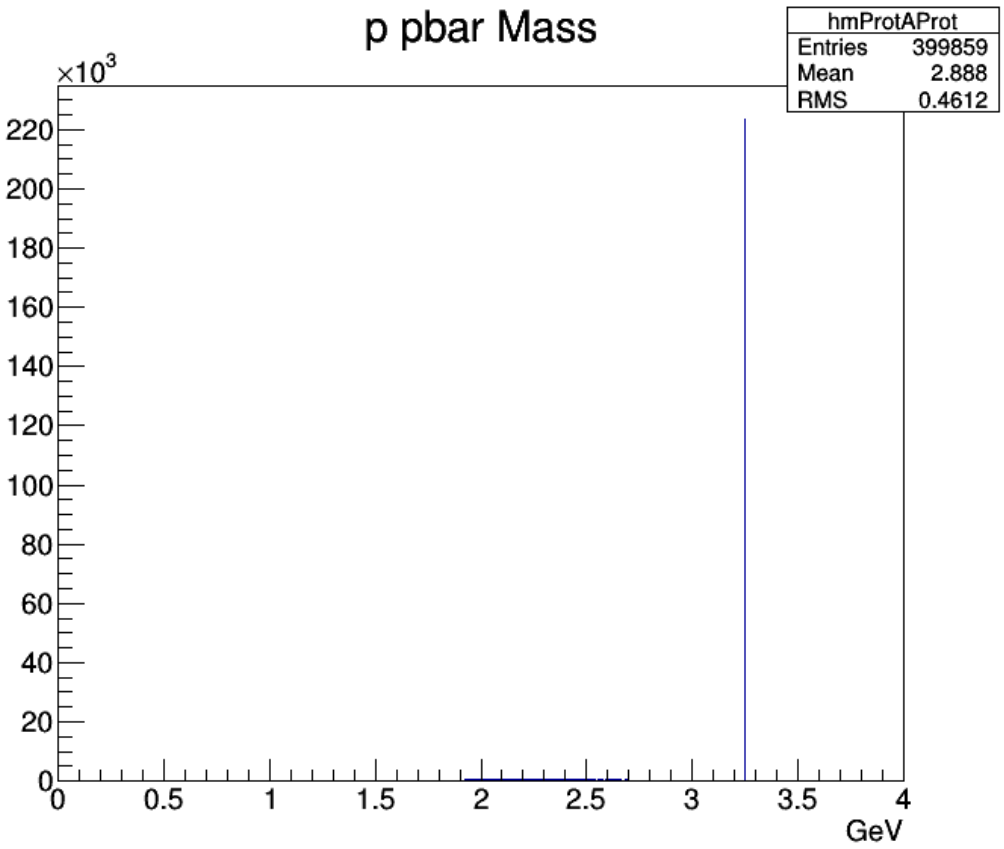
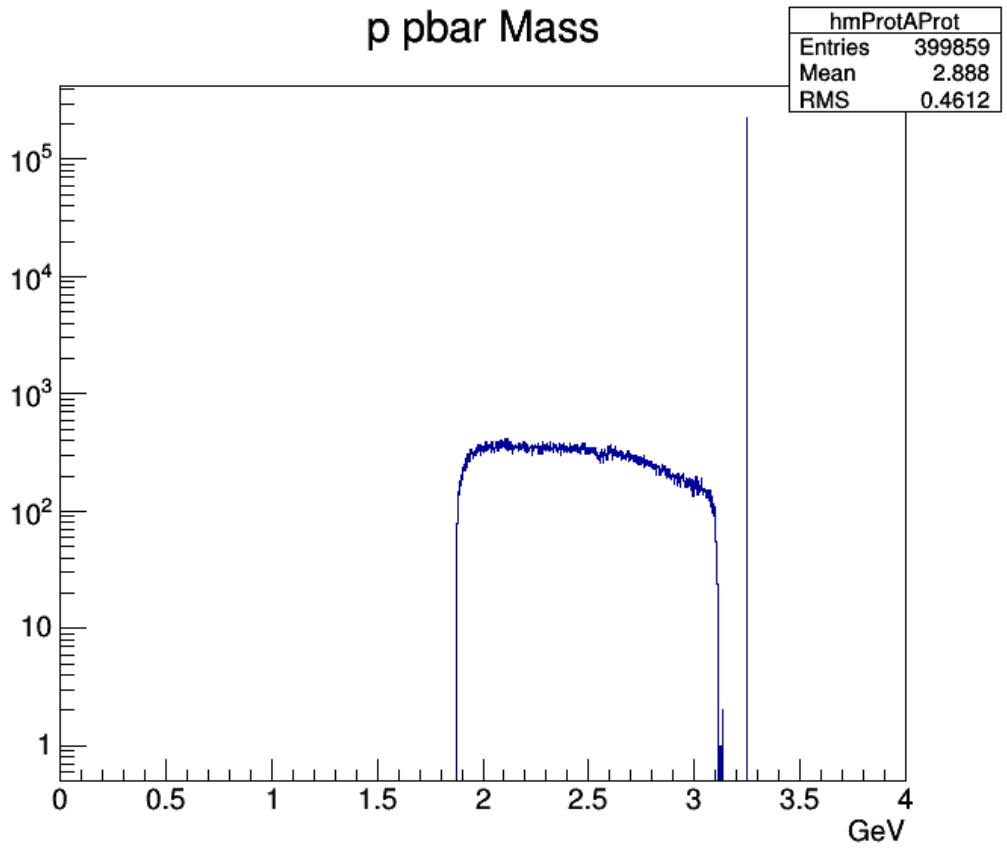
Entries 189797
Mean 1.408
RMS 0.2388
GeV


pbar π- Mass
hmAProtPim
Entries 112782
Mean 1.343
RMS 0.1823
GeV

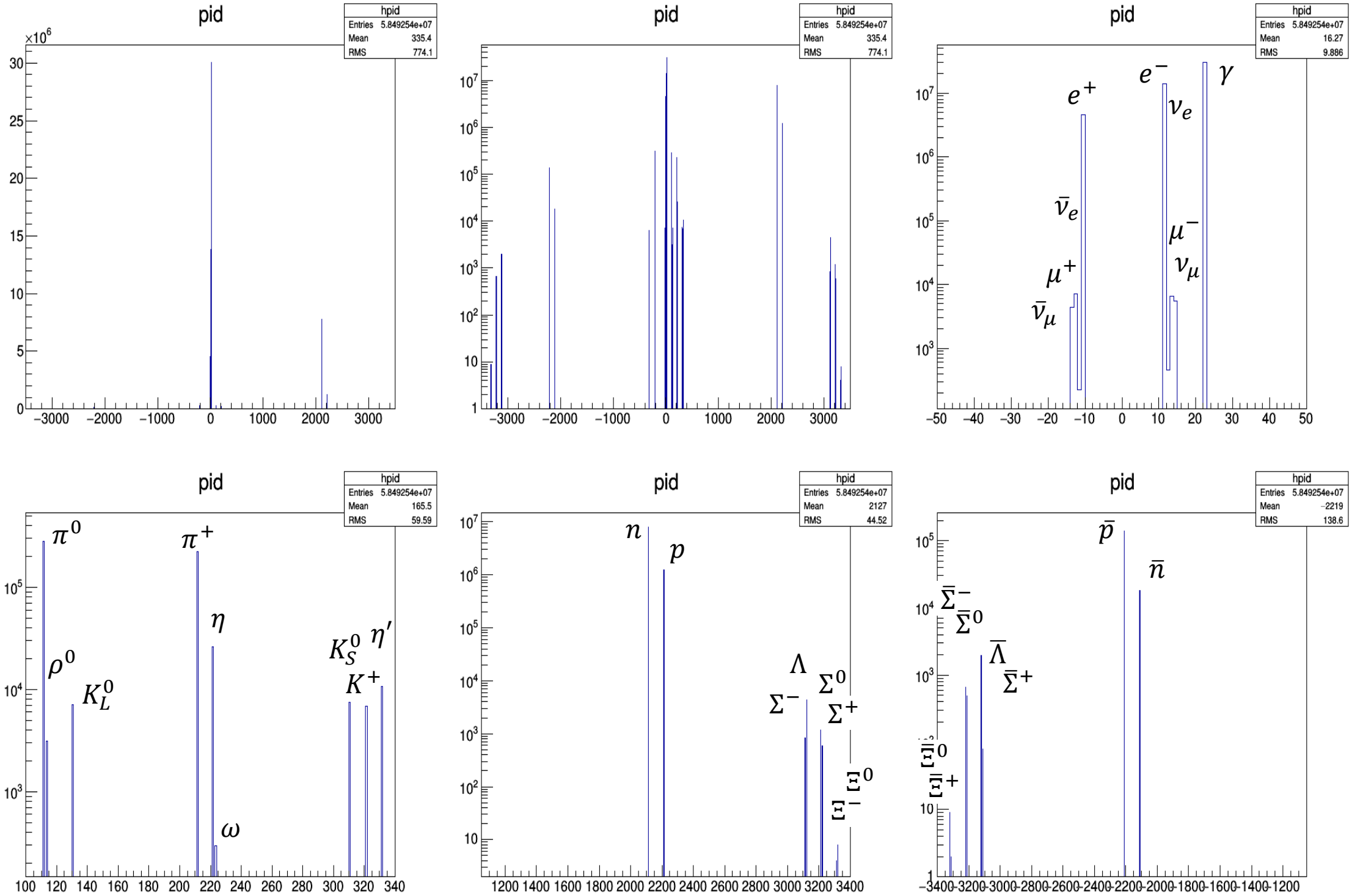

pbar π- Mass
hmAProtPim
Entries 112782
Mean 1.343
RMS 0.1823
GeV

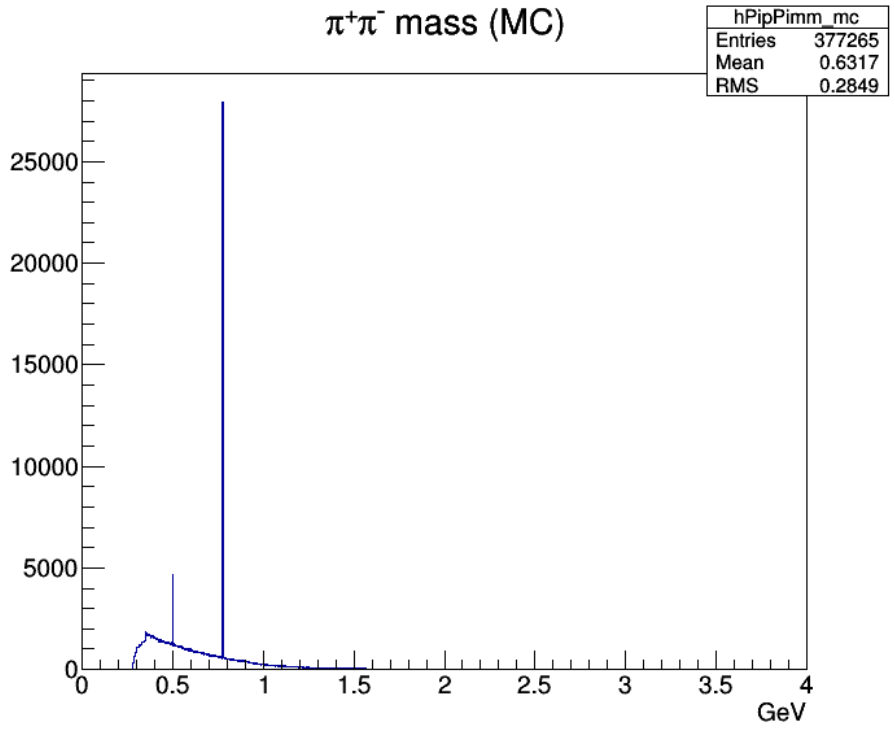

p pbar Mass
hmProtAProt
Entries 399859
Mean 2.888
RMS 0.4612
×10^3
220
200
180
160
140
120
100
80
60
40
20
0
0
0.5
1
1.5
2
2.5
3
3.5
4
GeV

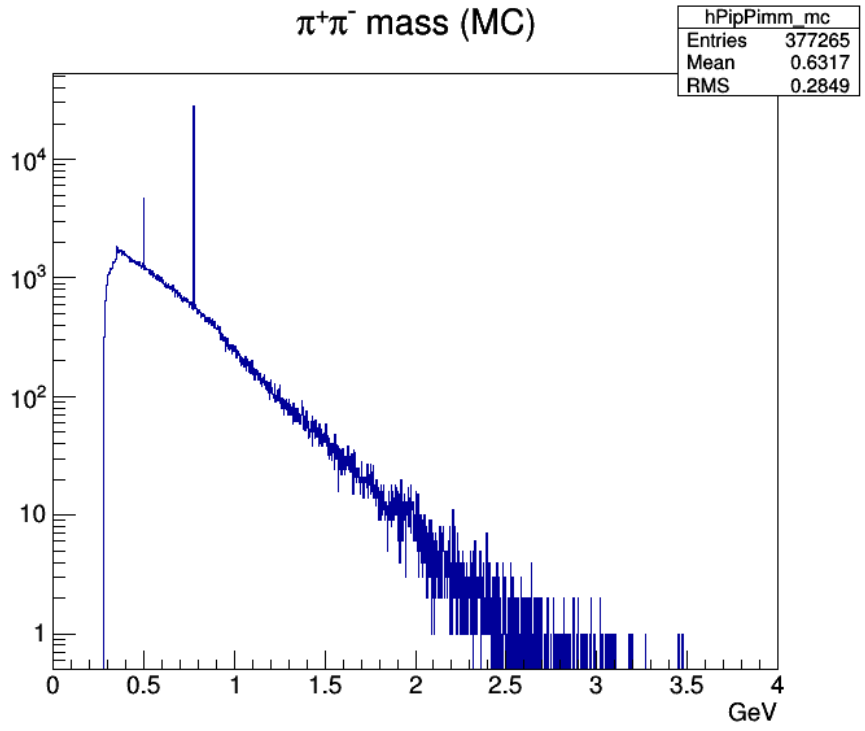

p pbar Mass
hmProtAProt
Entries 399859
Mean 2.888
RMS 0.4612
10^5
10^4
10^3
10^2
10
1
0
0.5
1
1.5
2
2.5
3
3.5
4
GeV

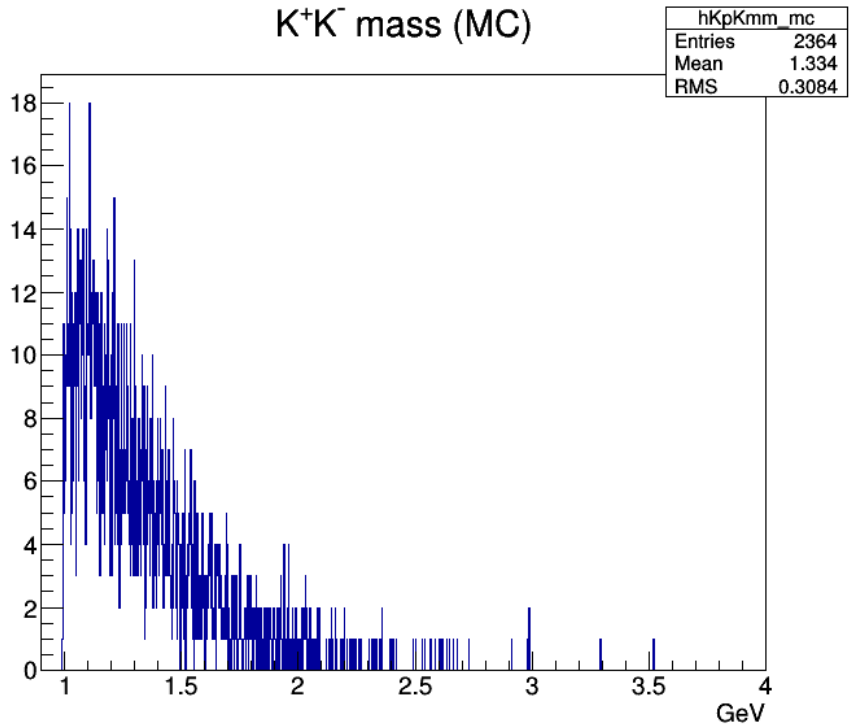
Box Generator Events: Simulation & Analysis

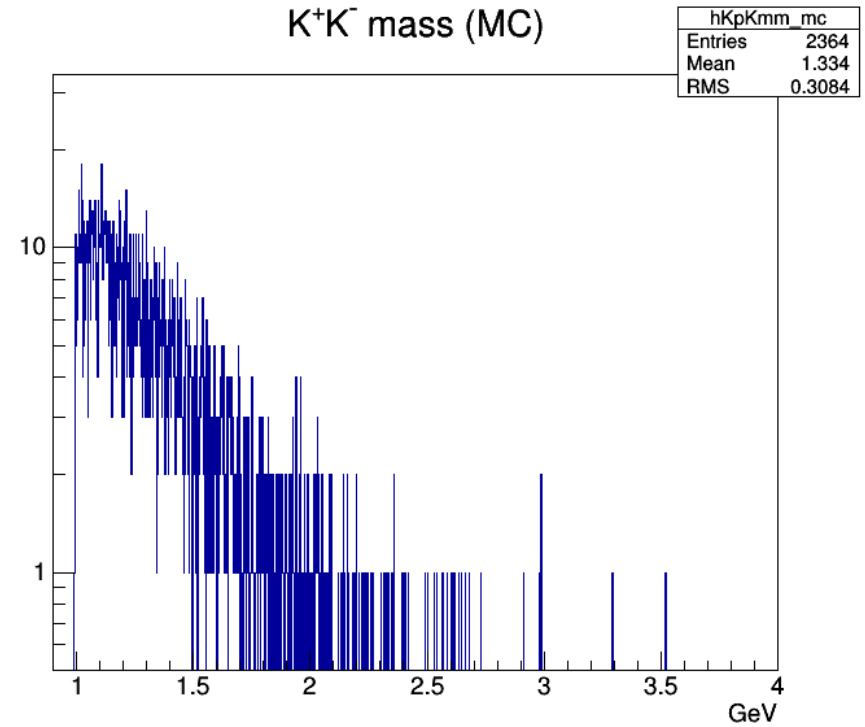
- 0.1 M events
- 4.6 GeV/c $\bar{p}$
- 1 $\bar{p}$ per event
- θ range: 5° – 45°
- φ range: 0° – 360°
- build 2-particle invariant mass spectra
- condition: common start point

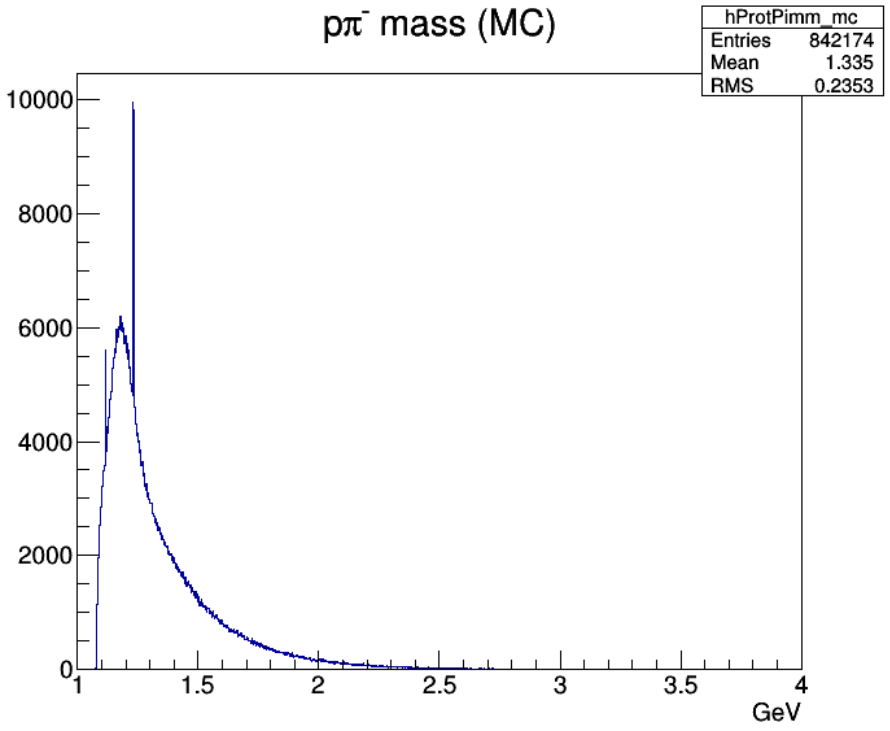

pid
hpid
Entries 5.849254e+07
Mean 335.4
RMS 774.1
pid
hpid
Entries 5.849254e+07
Mean 335.4
RMS 774.1
pid
hpid
Entries 5.849254e+07
Mean 16.27
RMS 9.886
e^+
e^-
γ
ν_e
$\bar{\nu}_e$
μ^-
μ^+
ν_μ
$\bar{\nu}_\mu$
pid
hpid
Entries 5.849254e+07
Mean 165.5
RMS 59.59
π^0
π^+
η
ρ^0
K_L^0
K_S^0
η'
K^+
ω
pid
hpid
Entries 5.849254e+07
Mean 2127
RMS 44.52
n
p
Λ
Σ^0
Σ^-
Σ^+
pid
hpid
Entries 5.849254e+07
Mean −2219
RMS 138.6
$\bar{p}$
$\bar{n}$
$\bar{\Sigma}^-$
$\bar{\Sigma}^0$
$\bar{\Lambda}$
$\bar{\Sigma}^+$

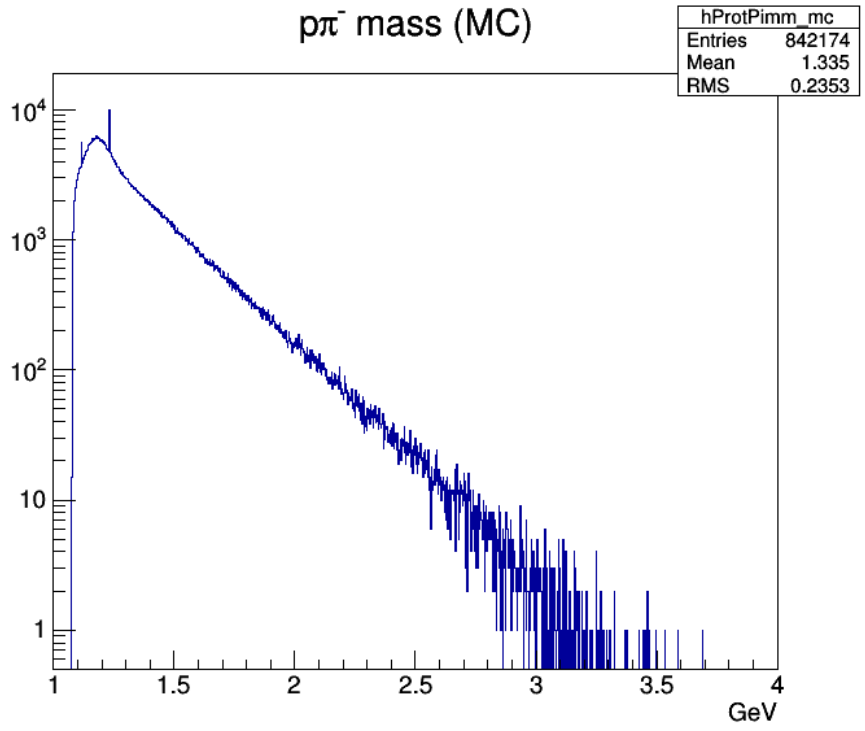

π+π- mass (MC)
hPipPimm_mc
Entries 377265
Mean 0.6317
RMS 0.2849
GeV

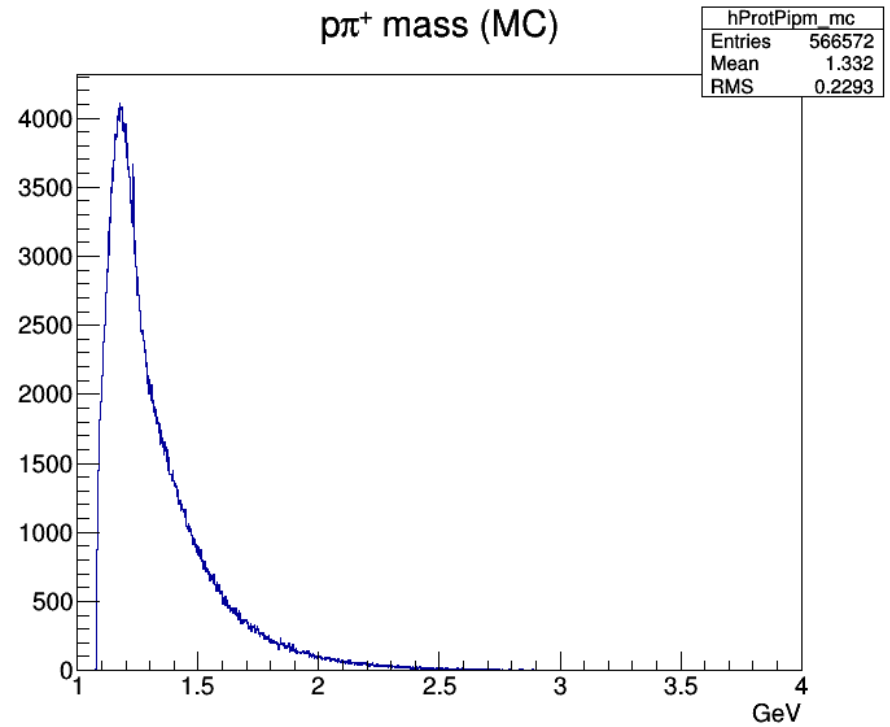

π+π- mass (MC)
hPipPimm_mc
Entries 377265
Mean 0.6317
RMS 0.2849
GeV

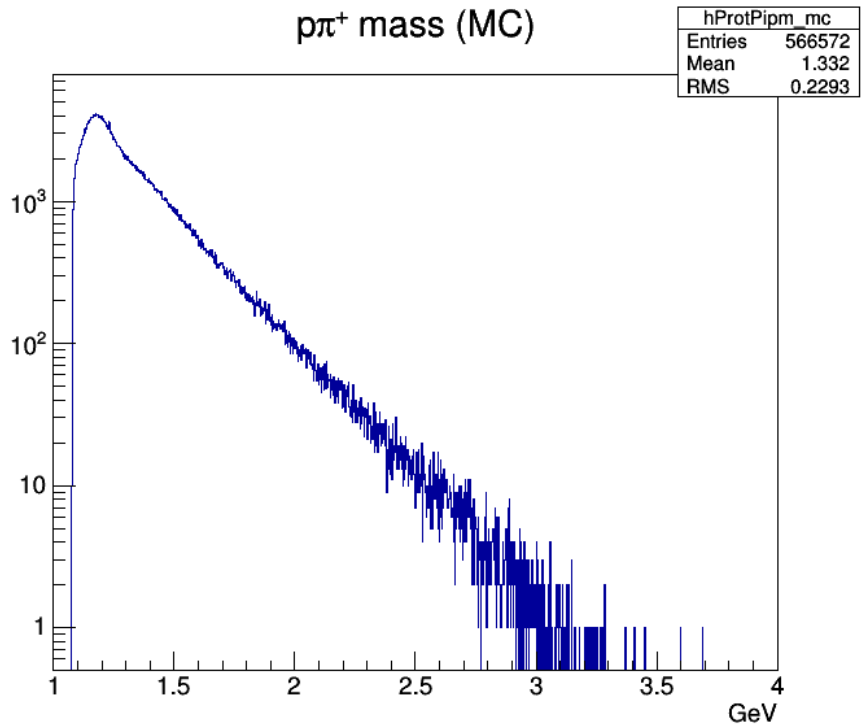

K+K- mass (MC)
hKpKmm_mc
Entries 2364
Mean 1.334
RMS 0.3084
GeV

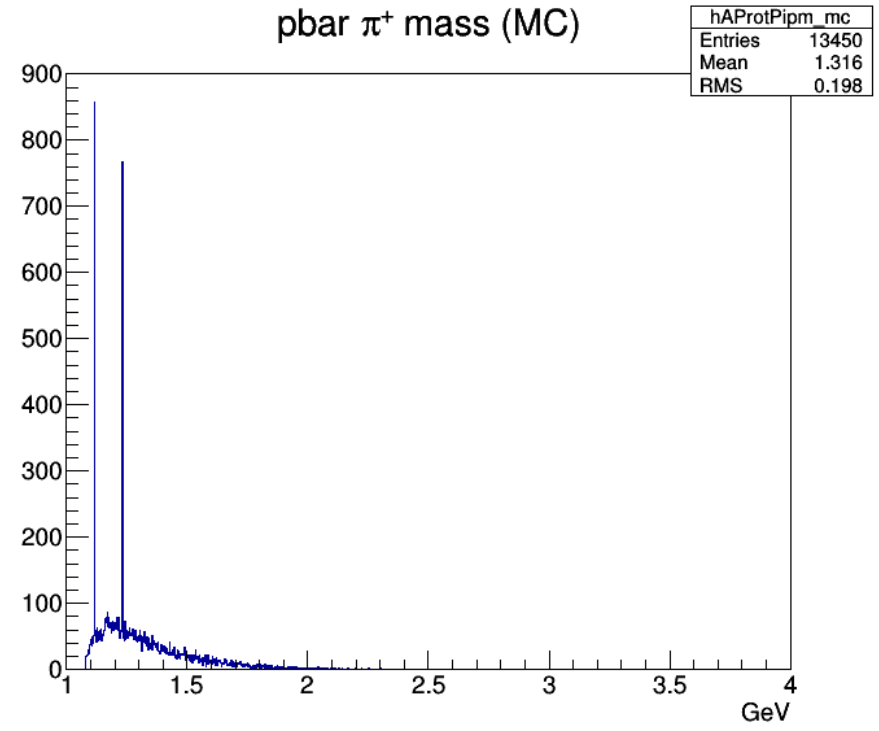

K+K- mass (MC)
hKpKmm_mc
Entries 2364
Mean 1.334
RMS 0.3084
GeV

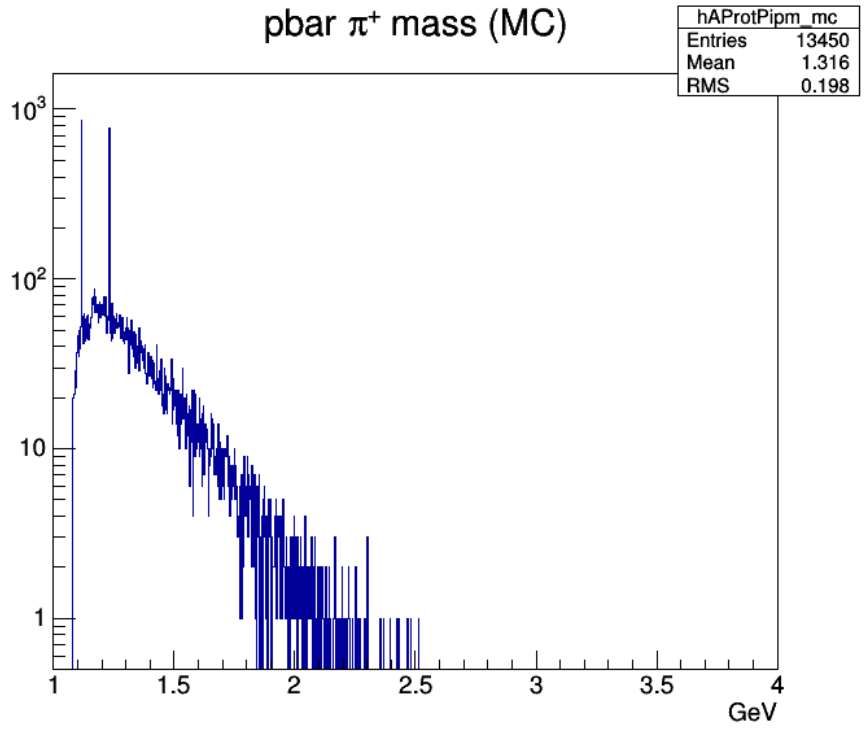

pπ⁻ mass (MC)
hProtPimm_mc
Entries 842174
Mean 1.335
RMS 0.2353
GeV

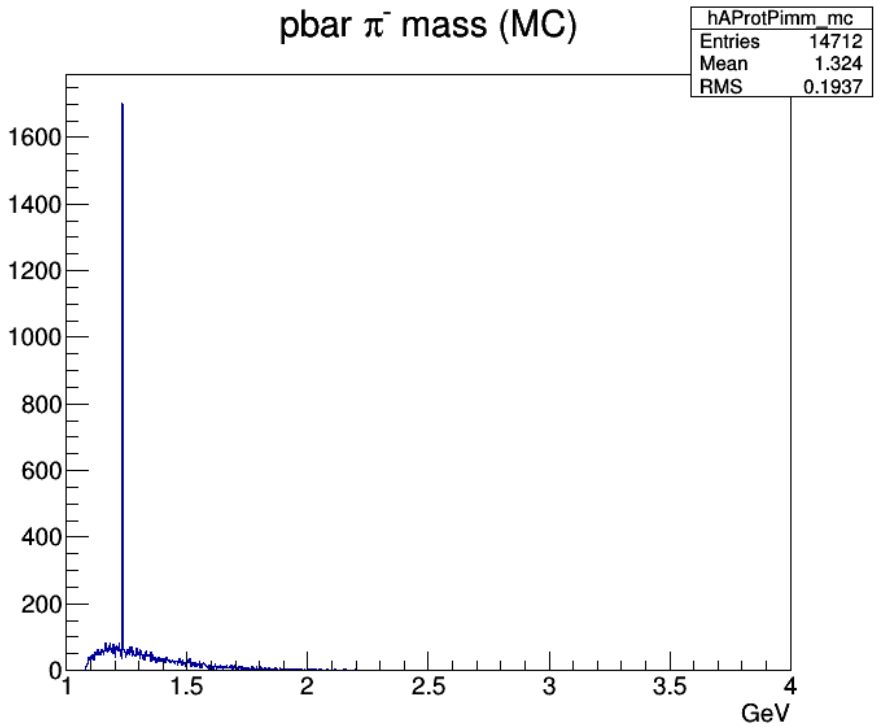

pπ⁻ mass (MC)
hProtPimm_mc
Entries 842174
Mean 1.335
RMS 0.2353
GeV

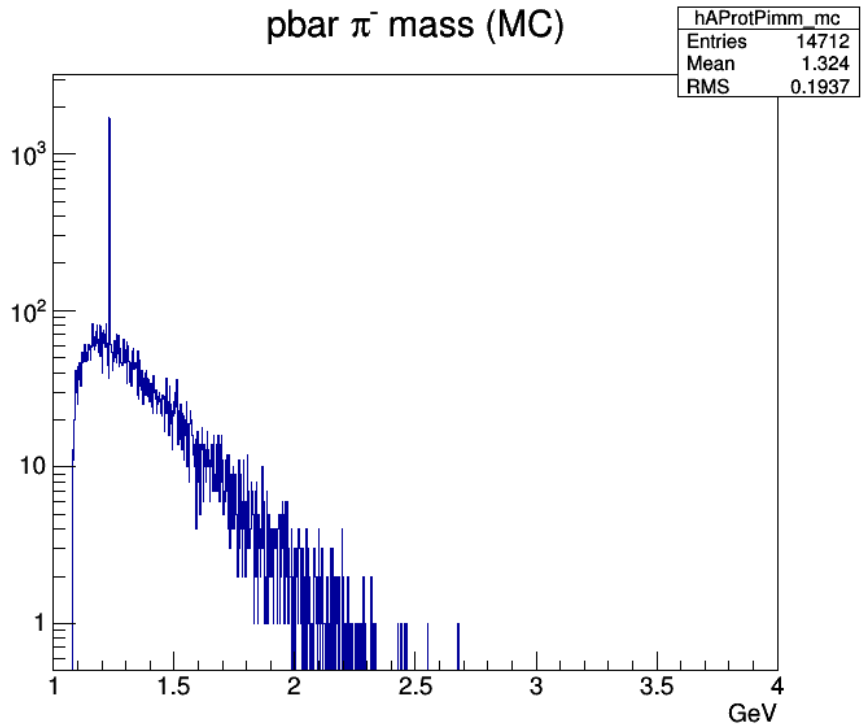

pπ⁺ mass (MC)
hProtPipm_mc
Entries 566572
Mean 1.332
RMS 0.2293
GeV

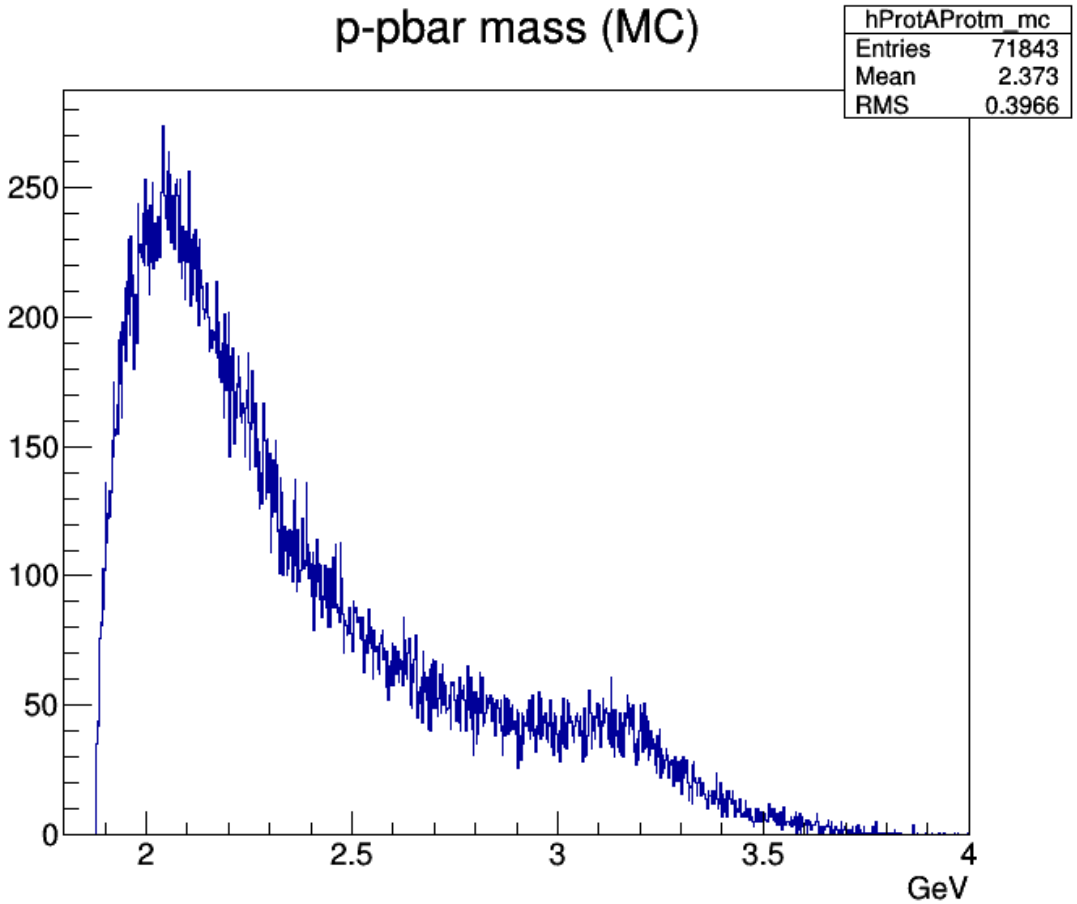

pπ⁺ mass (MC)
hProtPipm_mc
Entries 566572
Mean 1.332
RMS 0.2293
GeV

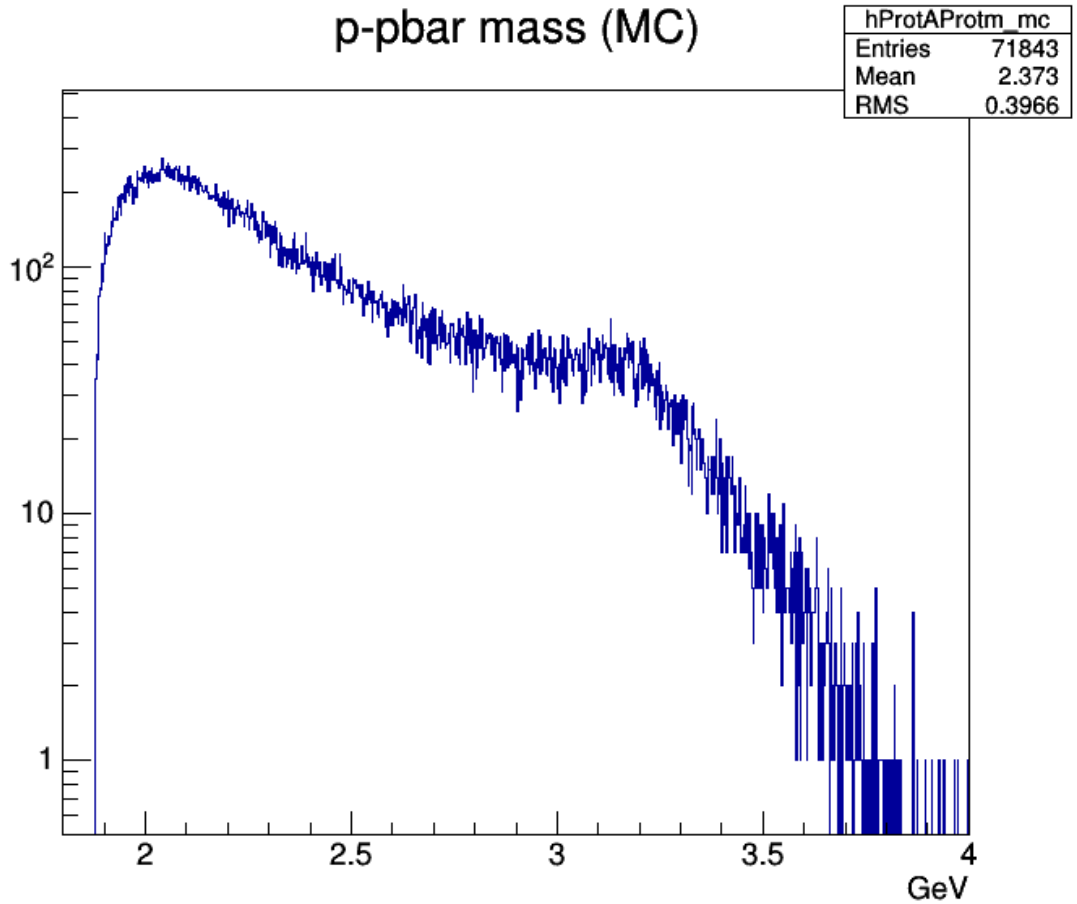

pbar π+ mass (MC)
hAProtPipm_mc
Entries 13450
Mean 1.316
RMS 0.198
GeV


pbar π+ mass (MC)
hAProtPipm_mc
Entries 13450
Mean 1.316
RMS 0.198
GeV


pbar π- mass (MC)
hAProtPimm_mc
Entries 14712
Mean 1.324
RMS 0.1937
GeV


pbar π- mass (MC)
hAProtPimm_mc
Entries 14712
Mean 1.324
RMS 0.1937
GeV


p-pbar mass (MC)
hProtAProtm_mc
Entries 71843
Mean 2.373
RMS 0.3966
250
200
150
100
50
0
2
2.5
3
3.5
4
GeV


p-pbar mass (MC)
hProtAProtm_mc
Entries 71843
Mean 2.373
RMS 0.3966
10^2
10
1
2
2.5
3
3.5
4
GeV

Summary

- Attempt to validate DPM data sample: construct 2-body invariant mass spectra from primary and secondary particles: spikes seen at nominal resonance peak positions of Δ, ρ and K^*
- DPM produces ‚strange' structures in $p\pi^-$, $\bar{p}\pi^+$ and $\bar{p}p$ spectra, but no zero-width resonances
- FTF does not show these most likely unphysical structures, but in contrast to DPM creates zero-width Δ, ρ and K^* states
- Test with Box Generator confirms production of zero-width composed states like Δ, ρ or K^* by Geant.