Validation of CMS 2010 Open Data

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CMS 2010 Open Data

- The various primary datasets in AOD format can be found at http://opendata.cern.ch/collection/CMS-Primary-Datasets
- Till now we have been working on the Minimum Bias, MuOnia, and Mu samples.

Minimum Bias dataset

We began validating the data by comparing p_T plots for various η ranges, with the corresponding plot given in the paper "**Transverse momentum and pseudorapidity distributions of charged hadrons in pp collisions at √s = 7 TeV"** by **The CMS Collaboration.**

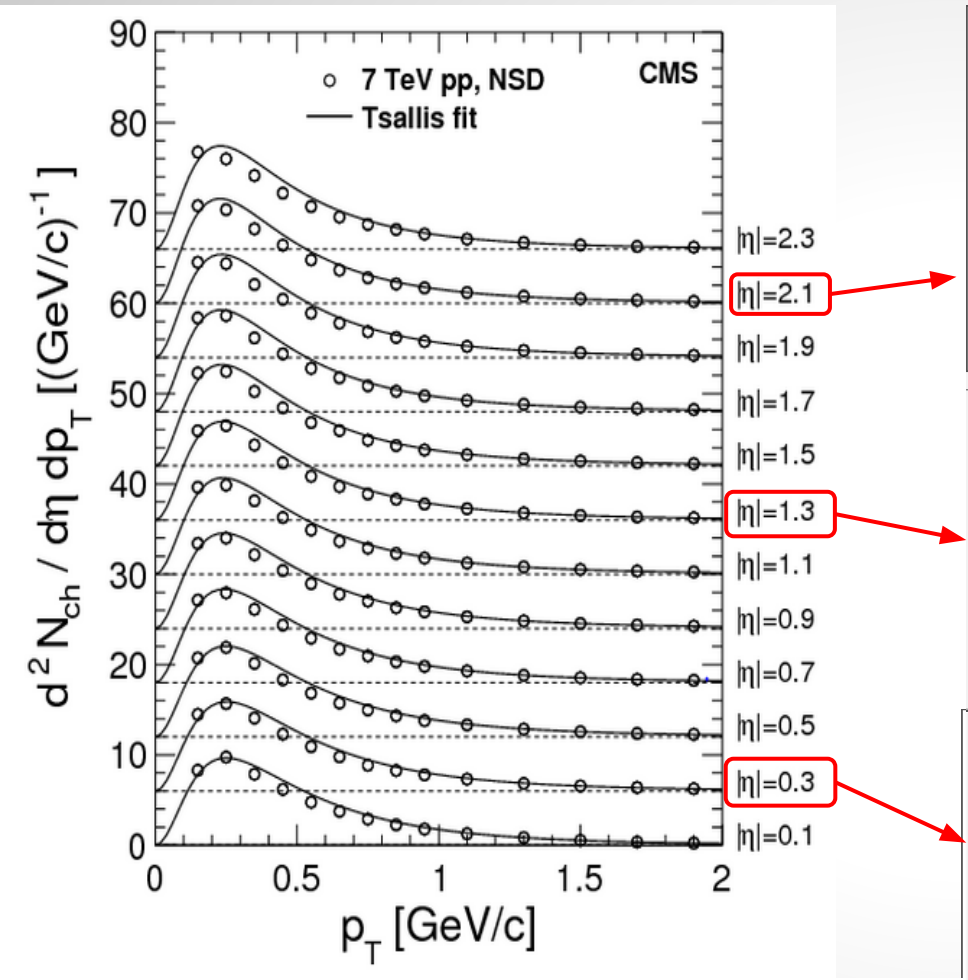
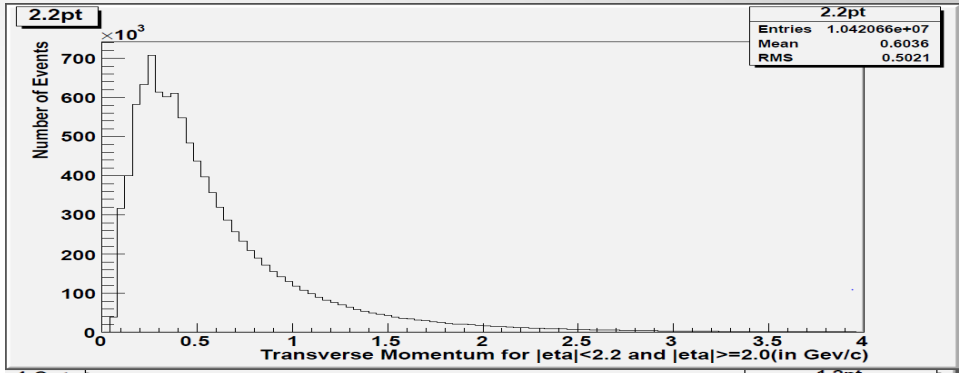
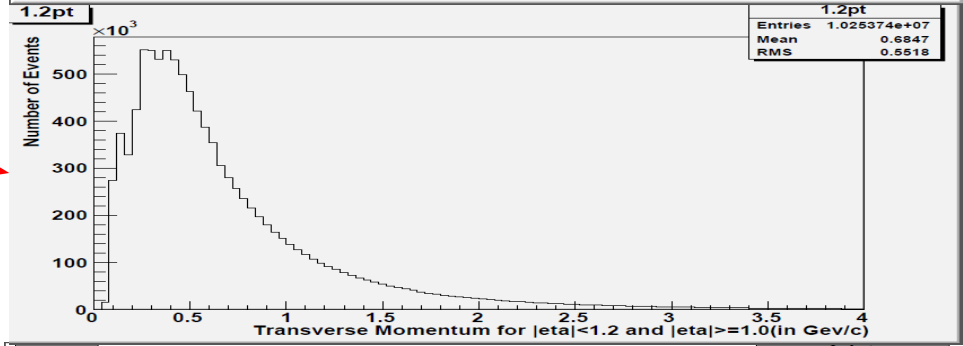
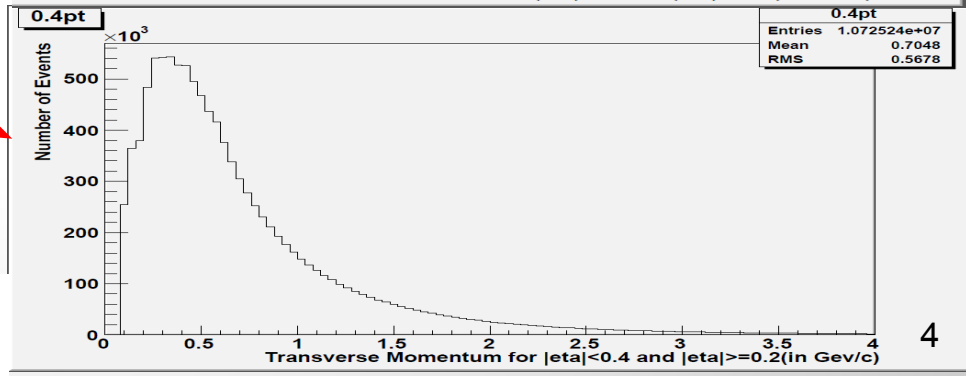


Figure 1: Differential yield of charged hadrons in the range $|\eta| < 2.4$ in 0.2-unit-wide bins of $|\eta|$ in NSD events. The solid curves represent fits of Eq. 1 to the data. The measurements with increasing η are successively shifted by six units along the vertical axis.







Cuts for Minimum Bias

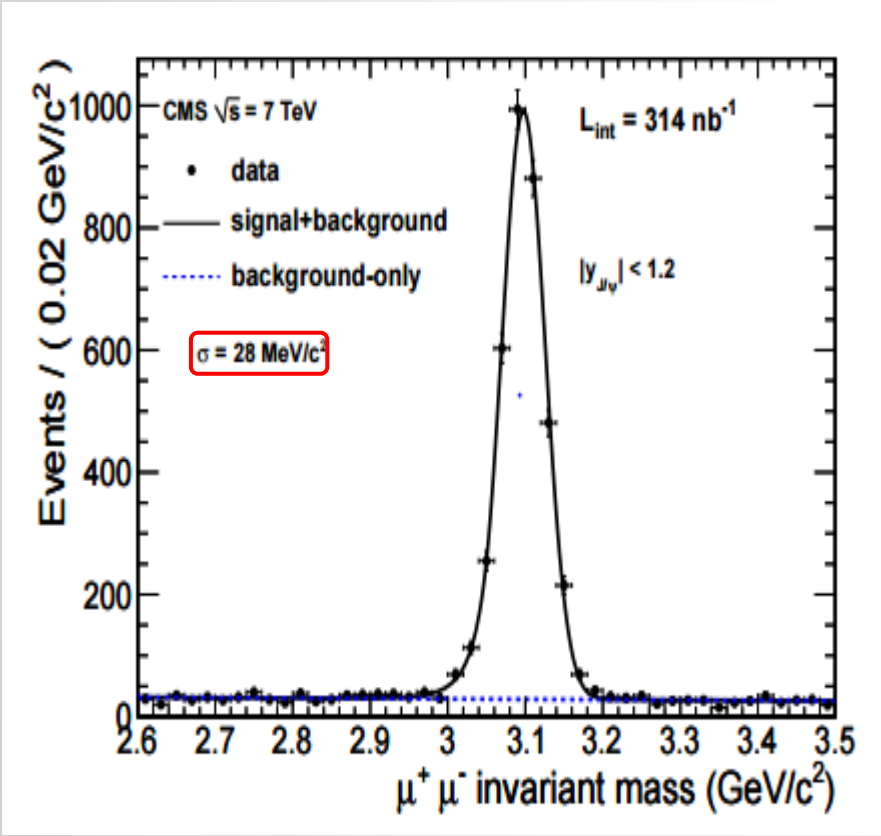
We have been reading the paper, but we couldn’t find a suitable cut that could be applied easily without getting into things like NSD or DD etc.

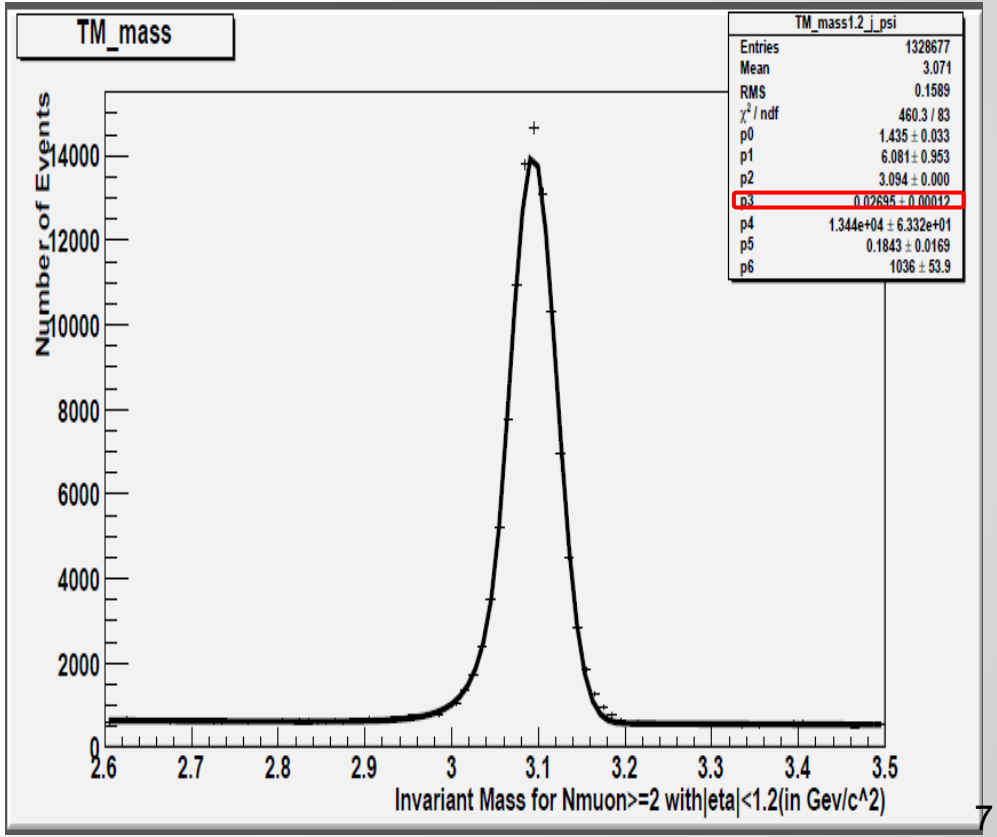
Suggestions are welcome!

MuOnia dataset

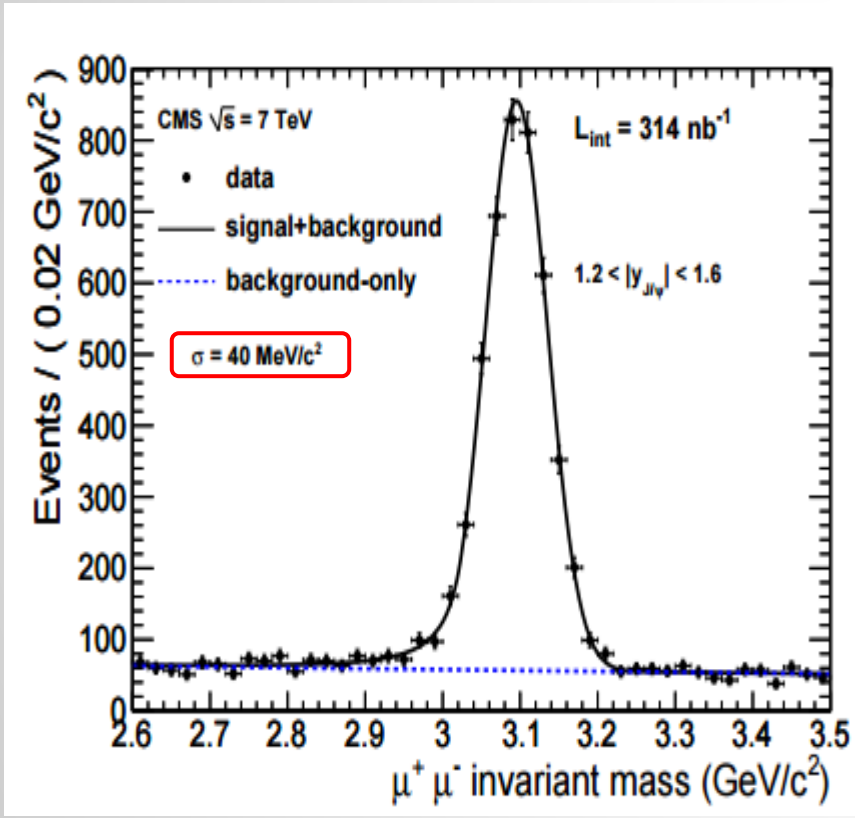
We tried to reproduce the J/ψ peak from this sample and compared it to the corresponding plots in the paper “**Prompt and non-prompt J/ψ production in pp collisions at $\sqrt{s}$ = 7 TeV**” by **The CMS Collaboration**.

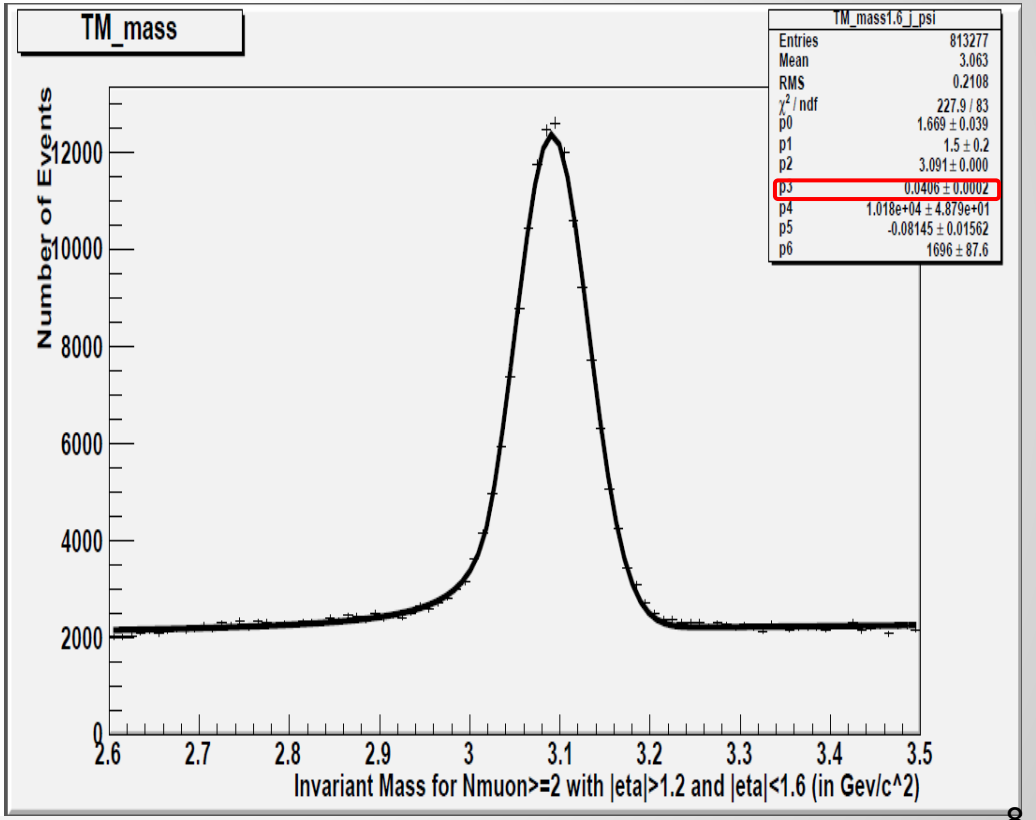
Invariant mass for |y|<1.2



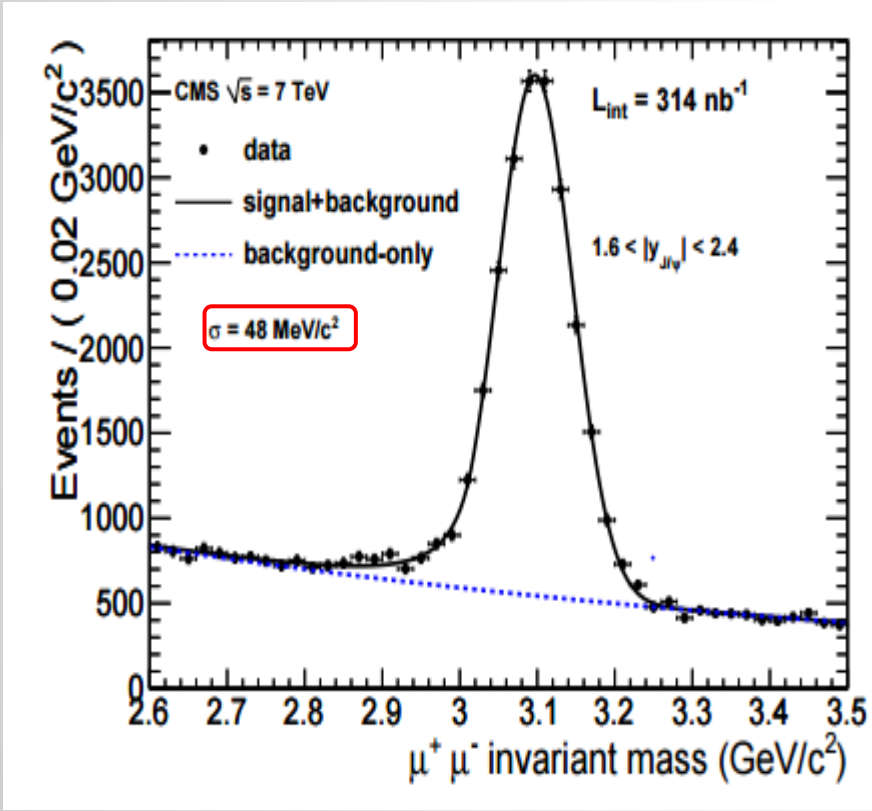


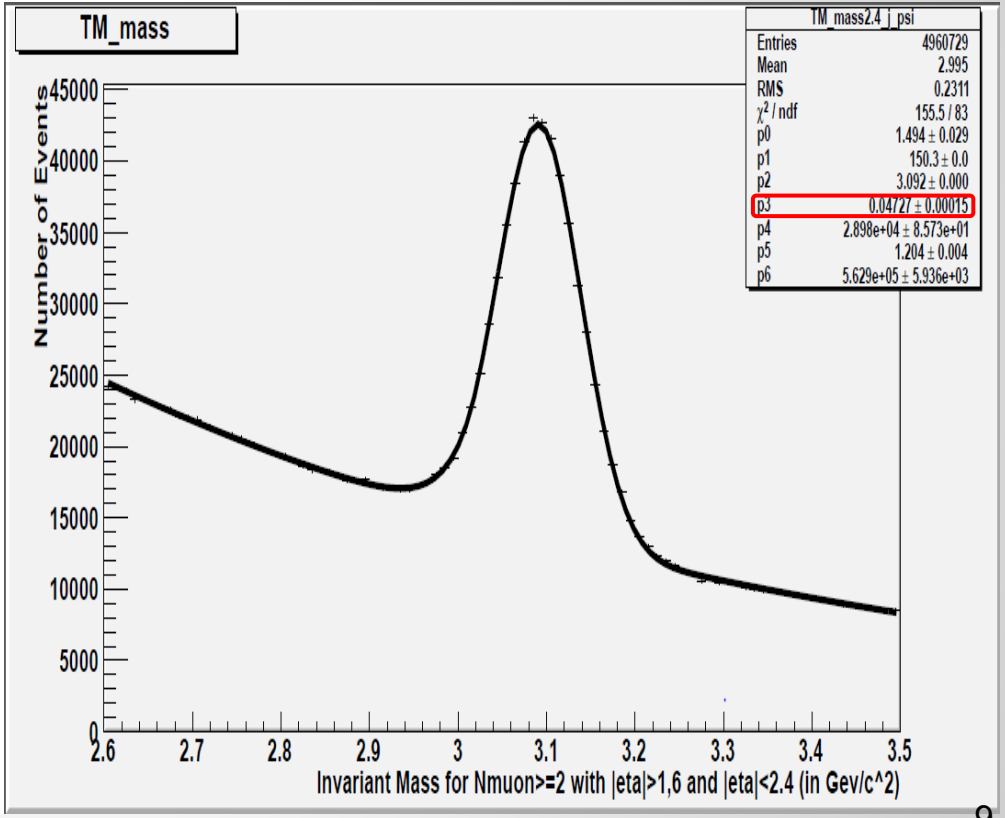
Invariant mass for 1.2<|y|<1.6





Invariant mass for 1.6<|y|<2.4





Triggers for the J/ψ sample

- Events were selected by a double-muon trigger that requires the detection of two independent muon segments at L1, without any further processing at the HLT.
- Events not coming from pp collisions, such as those from beam-gas interactions or beam scraping in the transport system near the interaction point, which produce a large activity in the pixel detector, are removed by requiring a good primary vertex to be reconstructed.

Cuts to be applied for the J/ψ

Track Reconstruction:

- **Global Muons**: $p_T \geq 4.0$ Gev/c in $|\eta| \leq 1.3$ and $p_T \geq 1$GeV/c in the forward region.
- **Tracker Muons**: better reconstruction efficiency at low momenta.
- Number of tracker hits -12, number of pixel hits - 2, $\chi^2 < 4.0$.
- Tracks must pass within a cylinder of radius 3 cm and length 30 cm centred at the primary vertex and parallel to beam line.
- **Transverse momentum correction**:

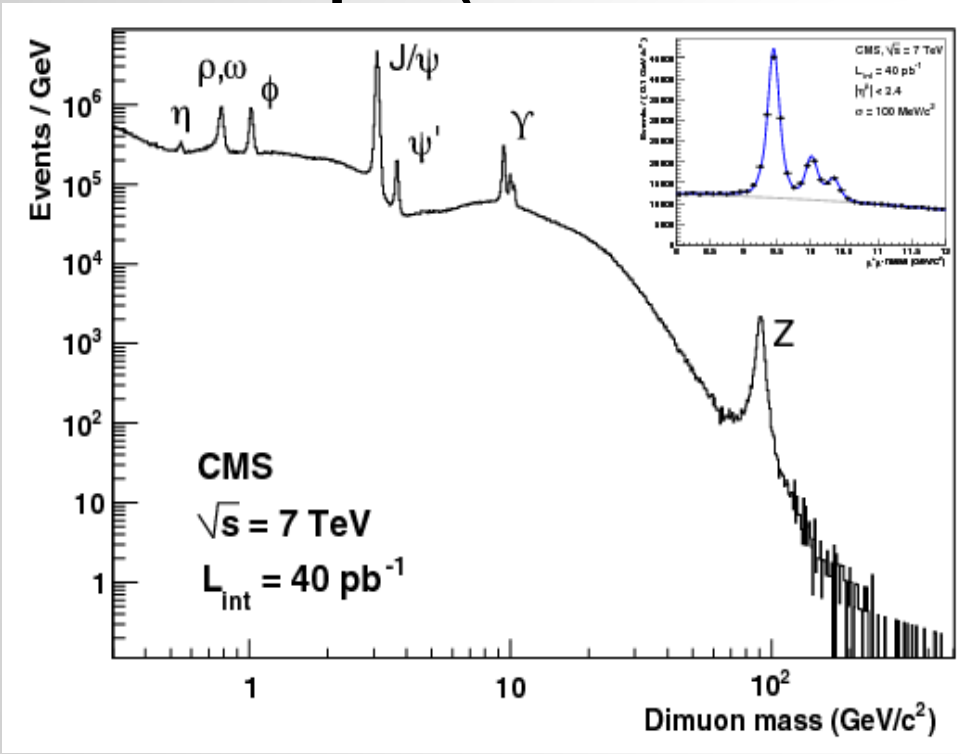
$p_T^{corr} = (1 + a_1 + a_2\eta^2) p_T^{meas}$, where p_T^{meas} is the measured muon transverse momentum with a_1 and a_2 values being $(3.8 \pm 1.9)10^{-4}$ and $(3.0 \pm 0.7)10^{-4}$.

Cuts to be applied for the J/ψ

Event Selection:

- Invariant mass of the muon pair should be between 2.6 and 3.5 Gev/c^2.
- The two muon trajectories must have a common vertex constraint and events are retained only if the fit χ^2 probability is larger than 0.1%.

A nice di-muon invariant mass distribution from the Mu sample!(4 million events and global muons only)



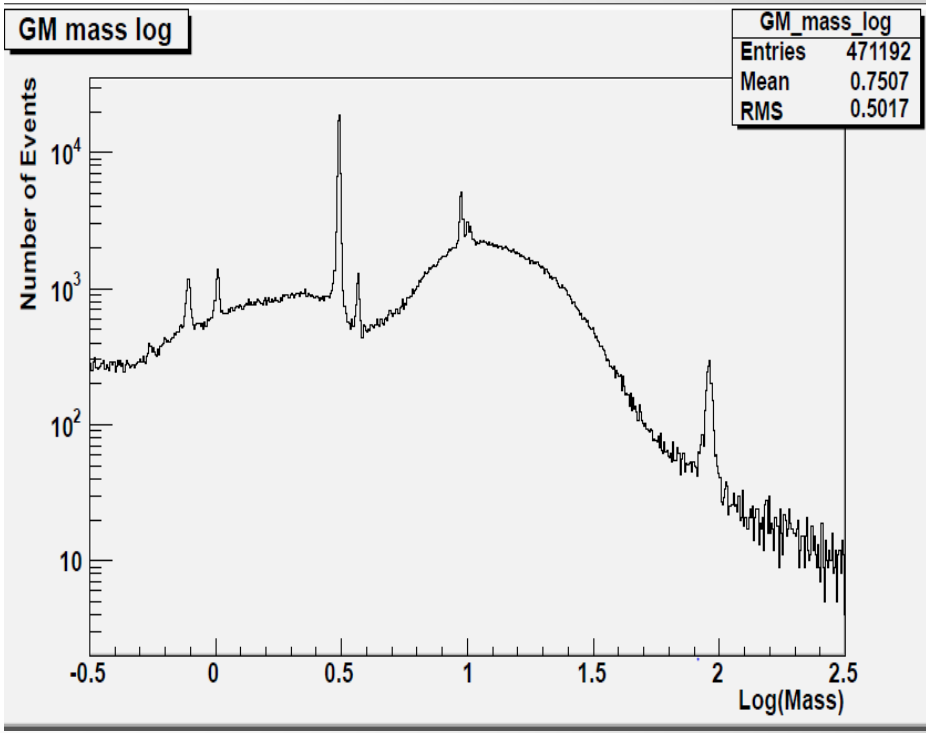
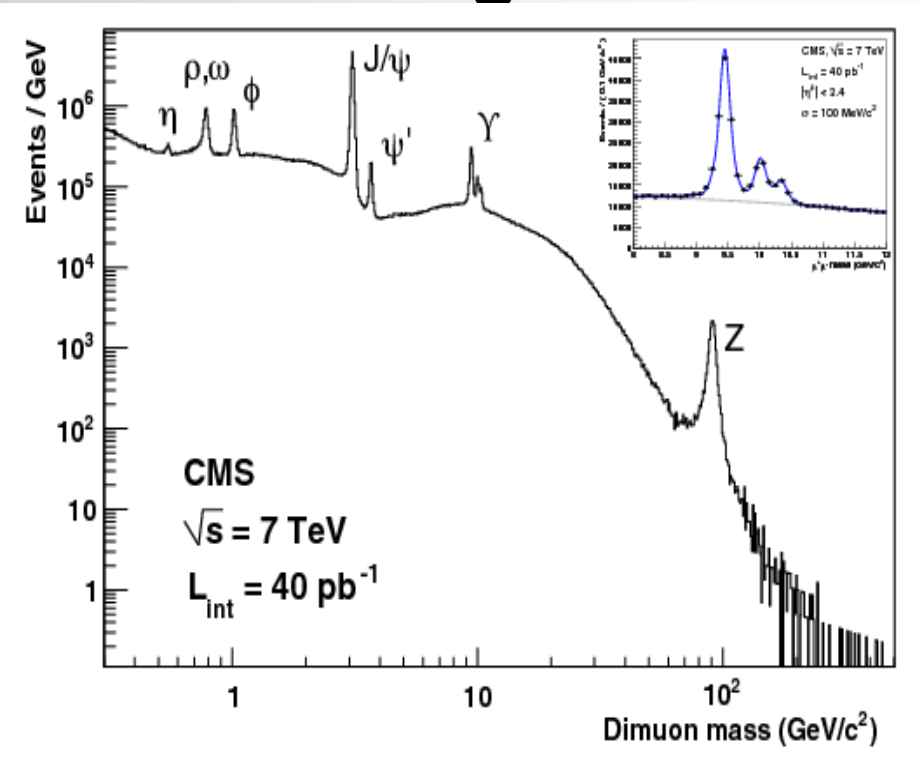


Figure taken from "**Performance of CMS muon reconstruction in pp collision events at √s=7 TeV**" by **The CMS Collaboration**

And now from the Mu Monitor sample (2 million events and global muons only)!



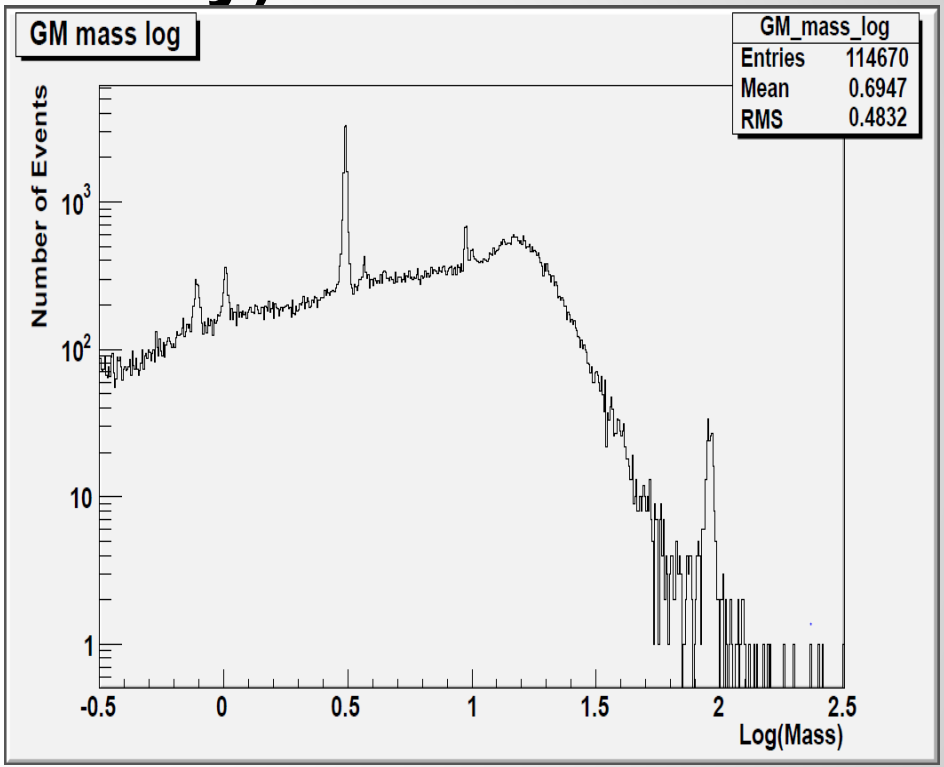
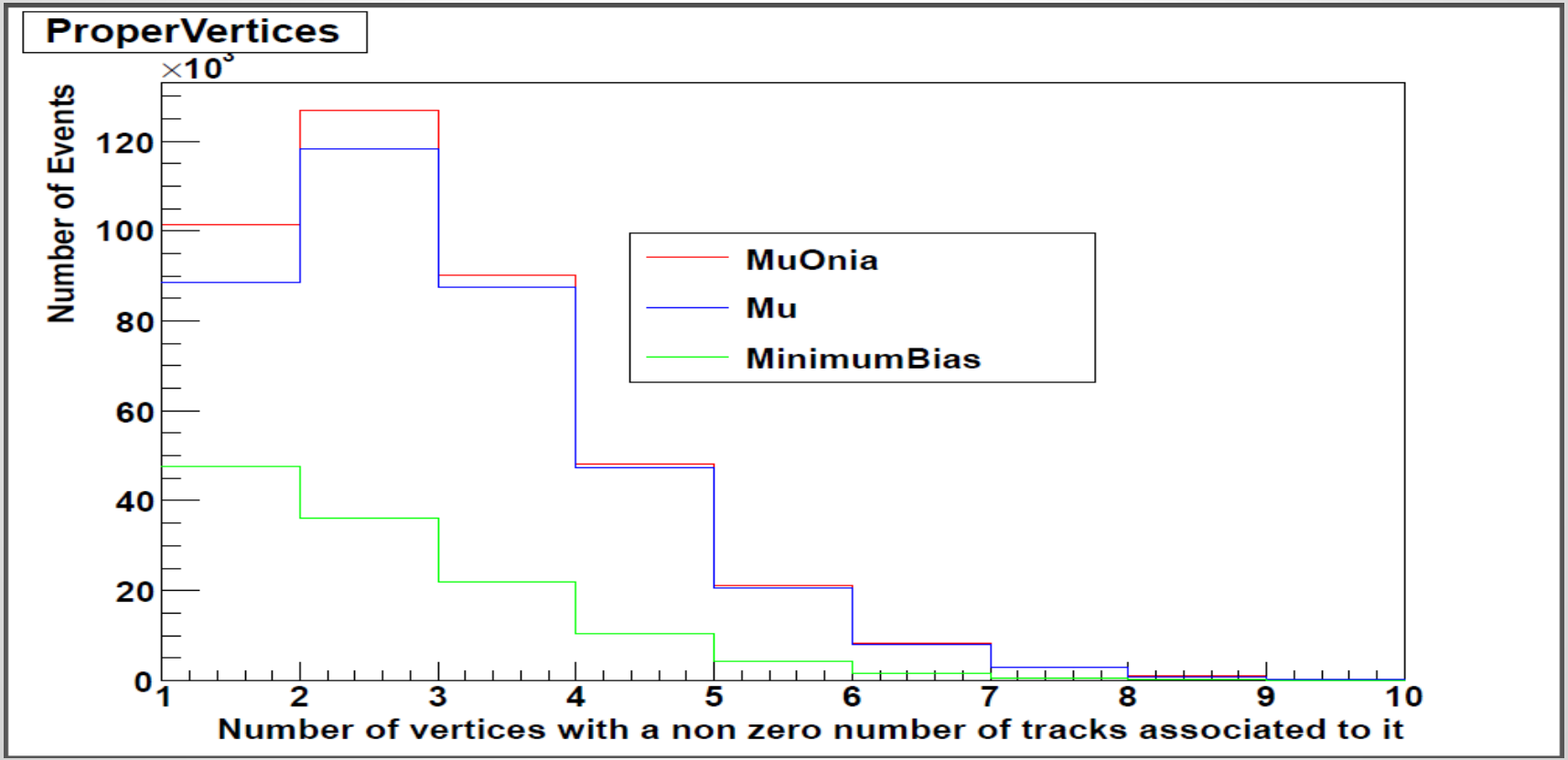


Figure taken from "**Performance of CMS muon reconstruction in pp collision events at √s=7 TeV**" by **The CMS Collaboration**

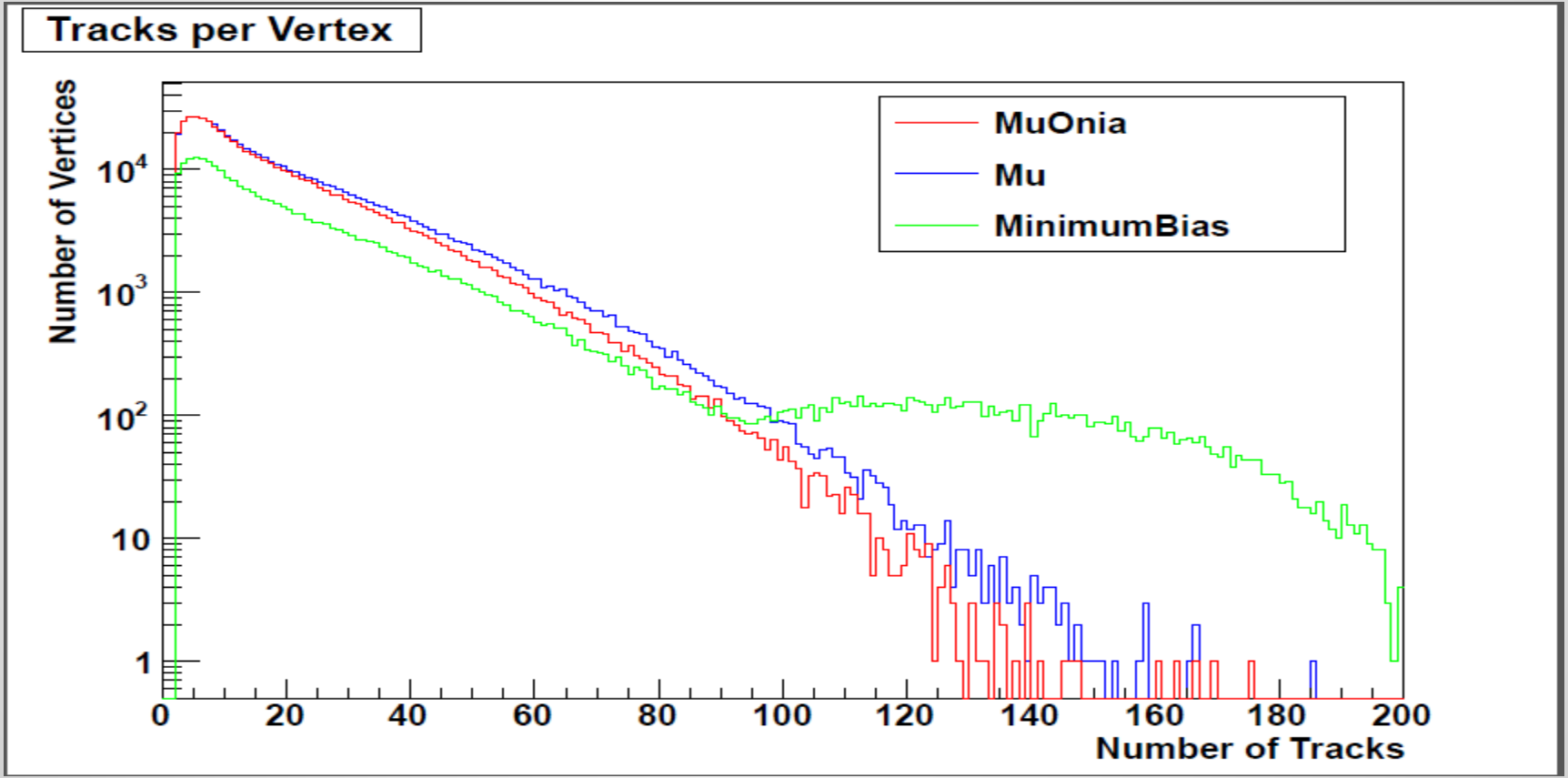
New Hypothesis...

We believe that if one removes those vertices which are associated to muons in the MuOnia or the Mu samples, the remaining should contribute for distributions which look very similar to the distributions of the Minimum Bias sample.

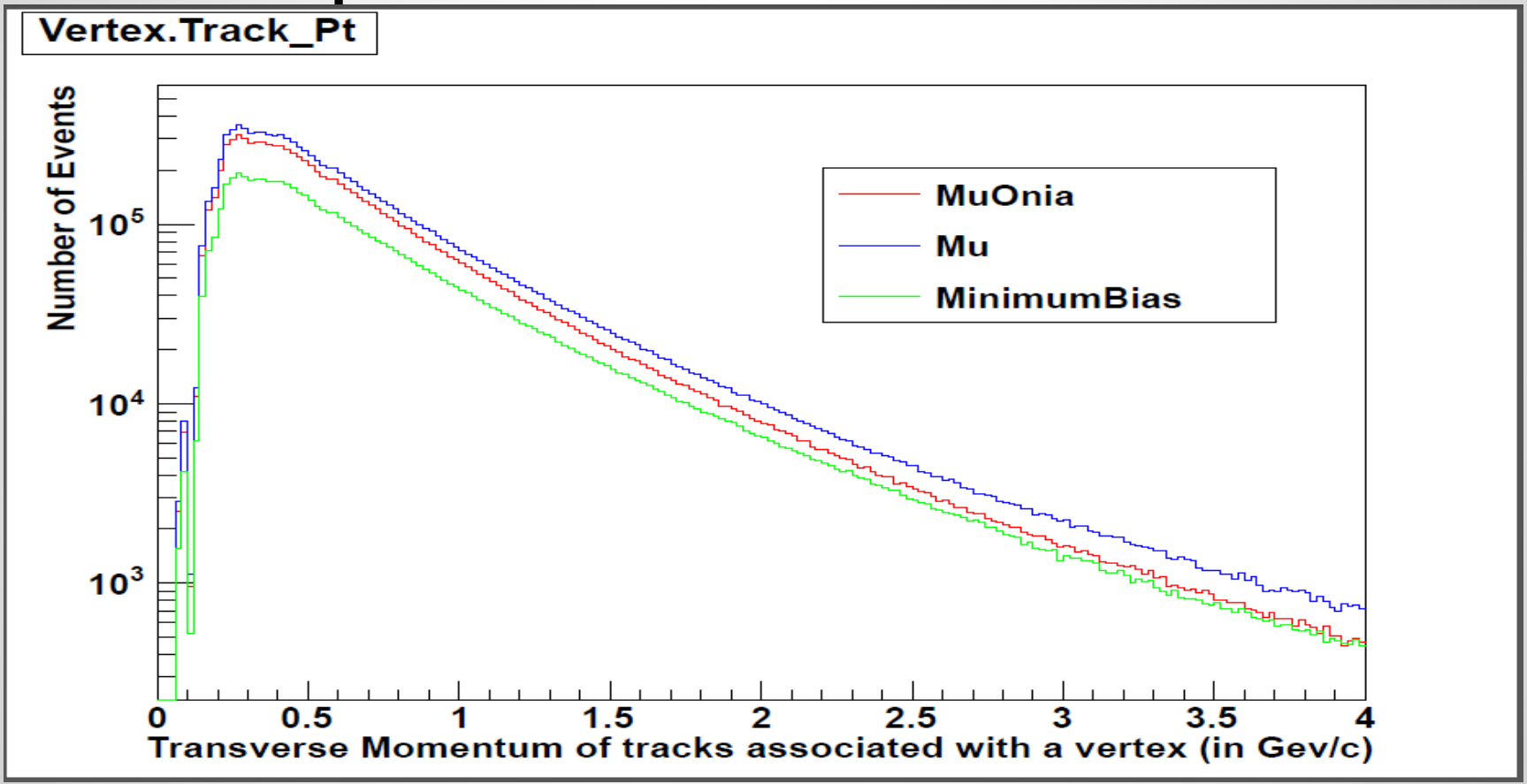
Vertex multiplicity



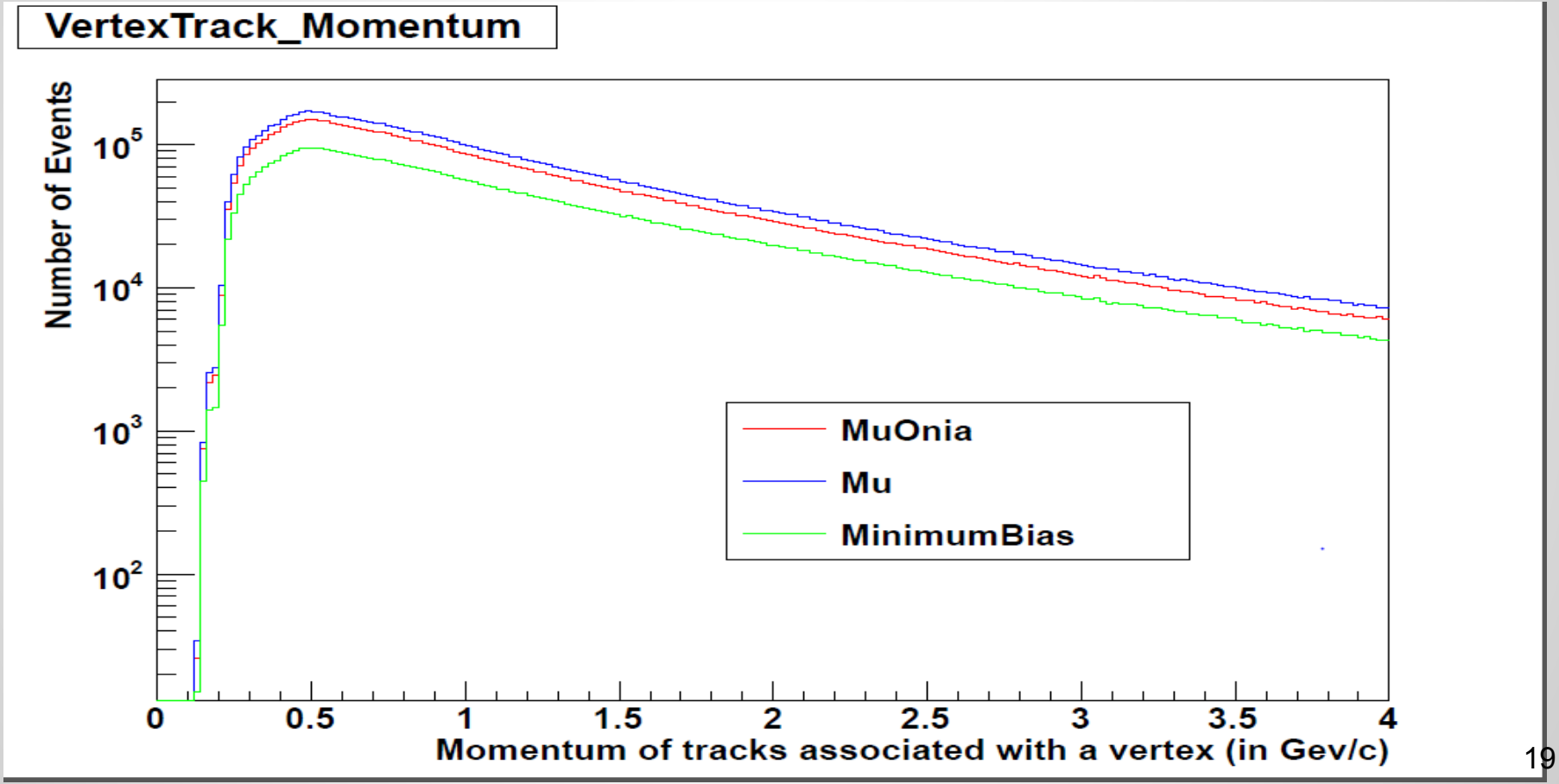
Track multiplicity per vertex



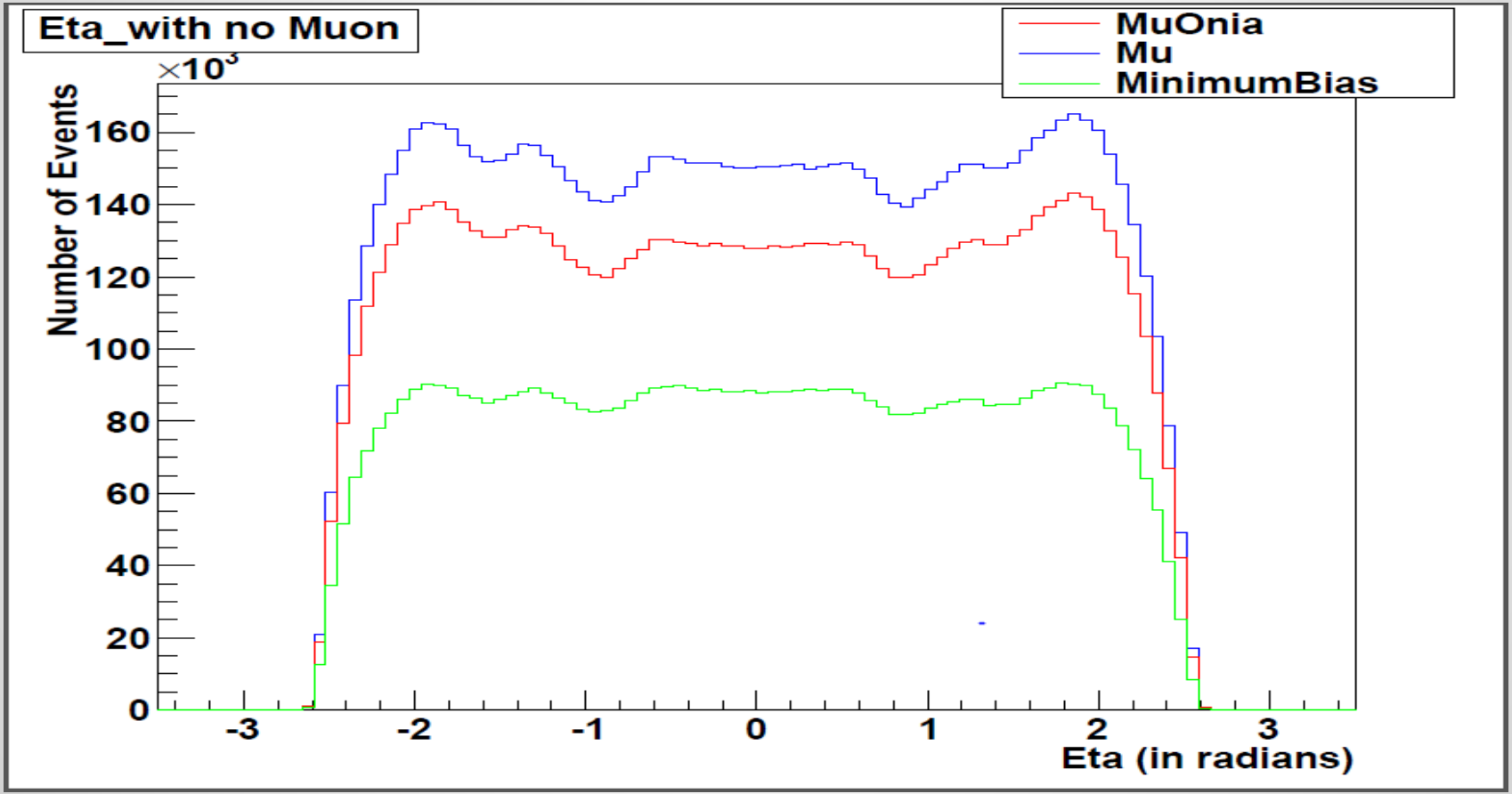
Track p_T


Vertex.Track_Pt
Number of Events
10^5
10^4
10^3
MuOnia
Mu
MinimumBias
0
0.5
1
1.5
2
2.5
3
3.5
4
Transverse Momentum of tracks associated with a vertex (in Gev/c)

Track momentum



η


Eta_with no Muon
MuOnia
Mu
MinimumBias
×10³
Number of Events
160
140
120
100
80
60
40
20
0
-3
-2
-1
0
1
2
3
Eta (in radians)

Things to do 

- Run over more statistics.
- Apply cuts implemented in the various papers, and get better and more refined plots.
- Use JSON txt file for good runs, as provided in the CMS open data portal.
- ……(the list never ends).