$J/\psi \rightarrow e^+e^-$ measurements in AuAu collisions at $\sqrt{s_{NN}}$ = 200 GeV at RHIC-PHENIX

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Outline

- Physics Motivation
- PHENIX Experiment
- Run2 AuAu experiment
- Status of Run4 AuAu experiment
- Analysis and e^+e^- Invariant mass
- Summary and Outlook

Physics Motivation

- Relativistic Heavy Ion Physics
  - Search for and characterize deconfined quark gluon plasma phase
- J/ψ measurements in Heavy Ion Physics
  - J/ψ Suppression due to Color Debye Screening

    T.Matsui and H. Satz PRL B178 (1986) 416
  - J/ψ Production by coalescence at RHIC energy (recombination of charm in the matter)

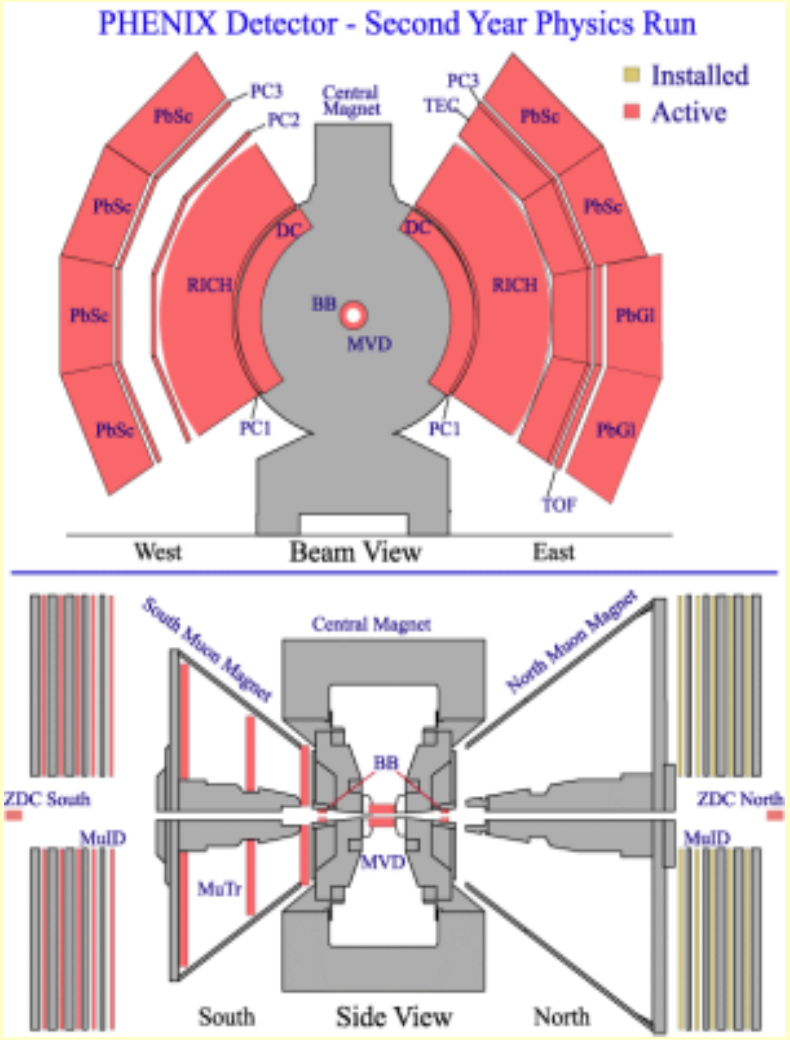
    R.L. Thews et. al. Phys. Rev. C63 054905 (2001)

    A. Andronic et. Al. Nucl-th/0303036

    L. Grandchamp, R. Rapp Nucl.Phys. A709, 415 (2002)

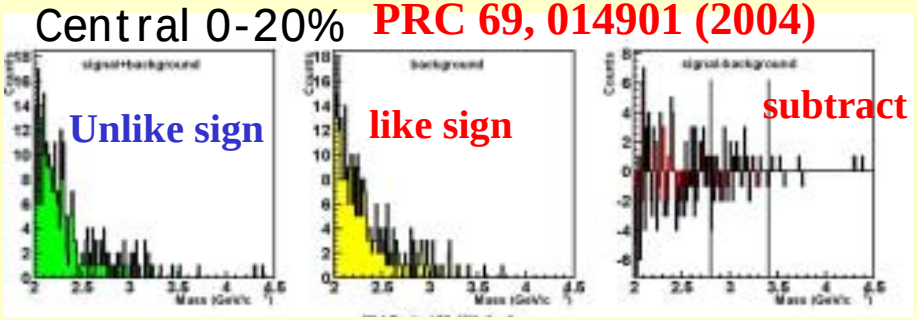
PHENIX Experiment

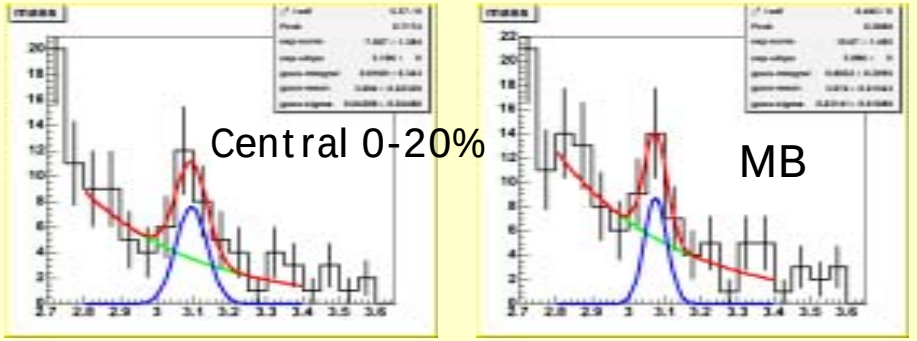
- Trigger, Centrality
  - BBC (transverse) and ZDC (forward)
- Central Arm Detectors
  - DC, PC (Tracking)
  - RICH, EMCal (electron ID)

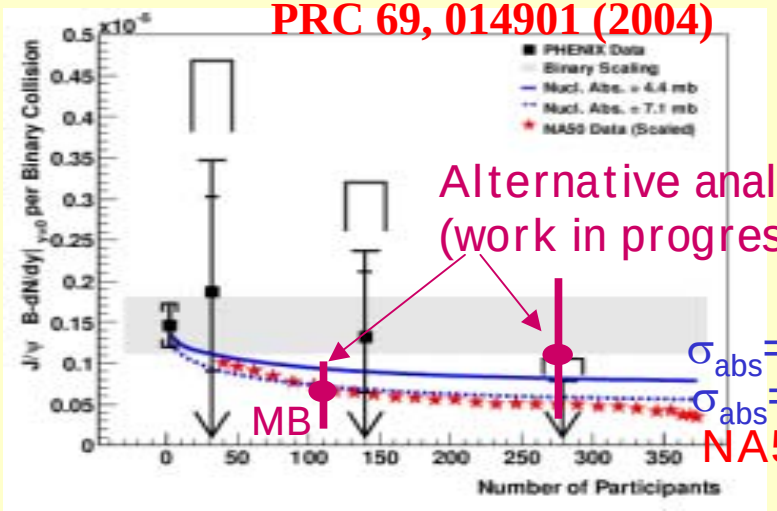


Run2 AuAu Experiment

- PHENIX run2 Au+Au data
  - 25.9M Min. Bias events
  - 24.9M LVL2 Triggered
- Alternative analysis
  - Correct Beam Position in transverse plane
  - Loosen eID cuts
    Hit PMTs in ring>=2, good track
  - High pT cut for e^+e^-
    0.6<pT<3GeV/c
- BdN/dY result
  - PHENIX Run2 analysis cannot distinguish the scenarios.
  - Alternative analysis result is still consistent with published result.







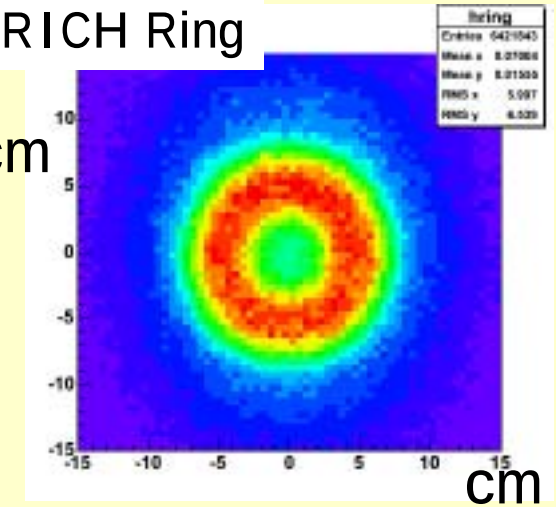
Status of Run4 AuAu Experiment

- AuAu collisions started from Jan. 4.
- Total 1.6 Billion events (~200 μb^{-1}) recorded
- About 2M LVL2 filtered events were analyzed.
  - Corresponds to < 10% of all the data.
  - LVL2 Dielectron Trigger
    - Construct tracks using EMCal hits and PC1 hits
    - Track association with PC3 and RICH
    - e^+ e^- candidate with RICH
    - Construct pair mass and accept if mass> 2.4 GeV

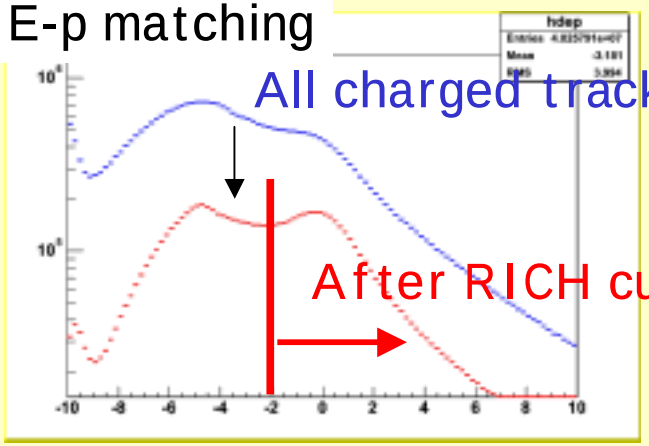
Analysis

- Event selection
  - BBC
    - |zvertex|<30 cm
- Electron ID
  - RICH
    - Hit PMTs in ring >=2
    - Ring shape
    - Distance btw ring center and track projection point
  - EMCal
    - Energy and momentum matching
      Dep = (E/p-1)/σ(E/p) > -2
- Track matching between DC and EMCal

RICH Ring

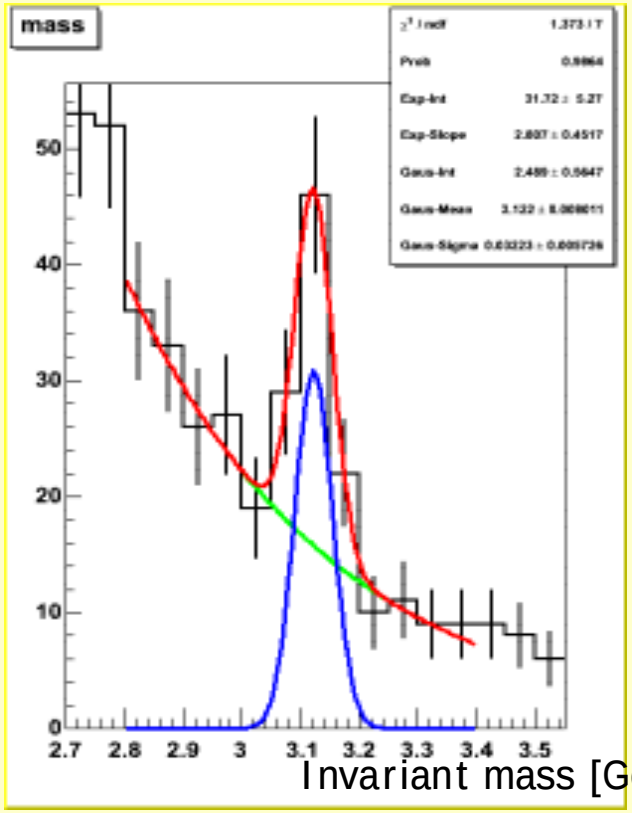


E-p matching



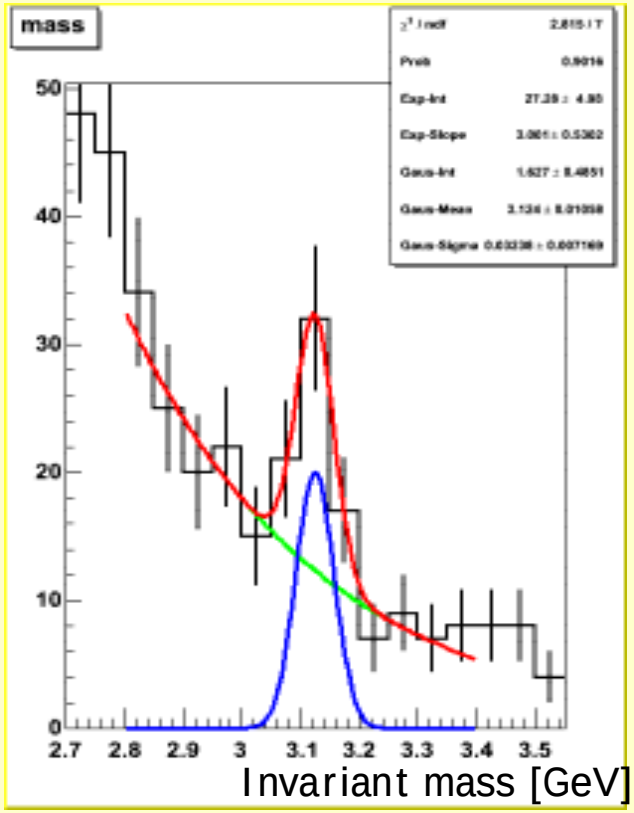
e^+e^- Invariant mass spectrum

Minimum Bias



$N_{J/\psi}$ = 49.8 +- 11.3
Mass Center = 3.12 +- 0.01 GeV
Mass Width = 32.2 +- 5.73 MeV

More central



$N_{J/\psi}$ = 32.5 +- 10.6
Mass Center = 3.12 +- 0.01 GeV
Mass Width = 33.4 +- 7.17 MeV

Summary and Outlook

- **PHENIX measured the J/ψ yield in Au+Au collisions at $\sqrt{s_{NN}}$ = 200 GeV**
  - PHENIX Run2 data cannot discriminate between various scenarios leading to suppression relative to binary scaling.
  - After refining eID cut parameters and correcting the beam position in transverse plane, J/ψ peak can be seen for MB and Central.

- **PHENIX Run4 data started to be analyzed.**
  - <10 % of all the data. Remaining data will be analyzed.
  - Clear peak can be seen for MB, more central events.
  - Cut parameters will be tuned.
  - MB events (not LVL2 filtered) will be analyzed.
  - BdN/dy will be evaluated.
    - Need to evaluate correction factors (with simulation).
      - Acceptance, eID efficency, Run-by-Run efficiency
      - Embeding efficiency, LVL2 trigger efficiency

Back up slides

- Data set and Cut parameters
- Strategy to extract J/ψ signals
- Fit range dependence of $N_{J/\psi}$

Data sets & cut parameters

Data sets :

Run4 EWG_Dielectron 7245 files (→ ~90 M events)

Cut Parameters :

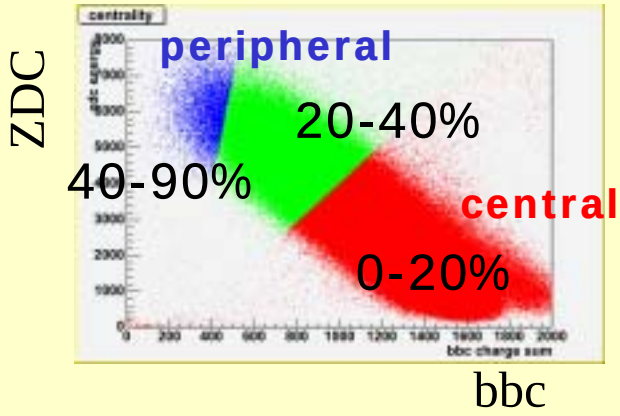
- BBC
  - |bbcz|<30 cm
- RICH
  - n0>=2
  - disp<5
  - chi2/npe <20
- sqrt(emc_dz^2+emc_dphi^2)<4
- dep=(E/p-1)/σ(E/p)>-2
- Ghost cuts

  |zed^1-zed^2|<0.2 |phi^1-phi^2|<0.02

  cos(p^{1}p^2)>0.999

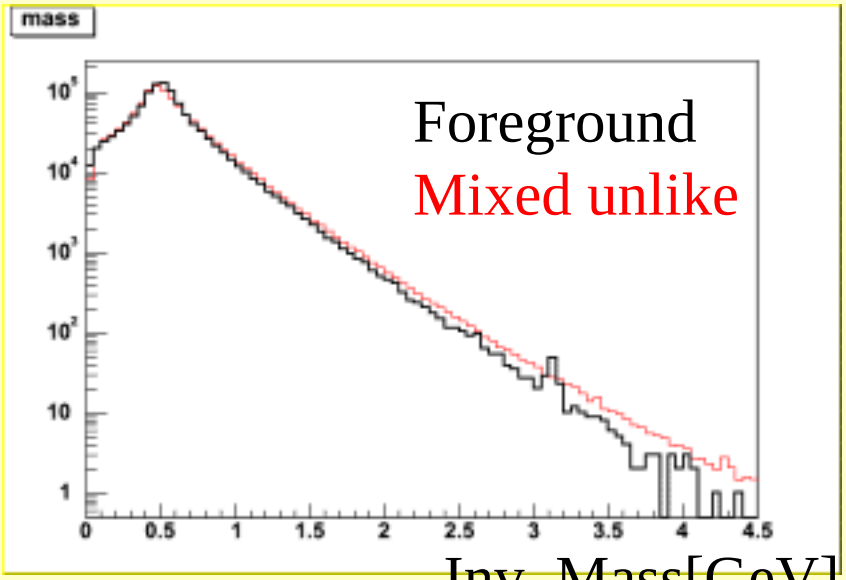
Centrality

I used "centclock" variable in nano-DST to define the centrality.



- Due to the LVL2 filtered, less statistics for peripheral.
- The definition is the same as that of Run2
- Approximately correct?

Strategy to extract J/ψ signals



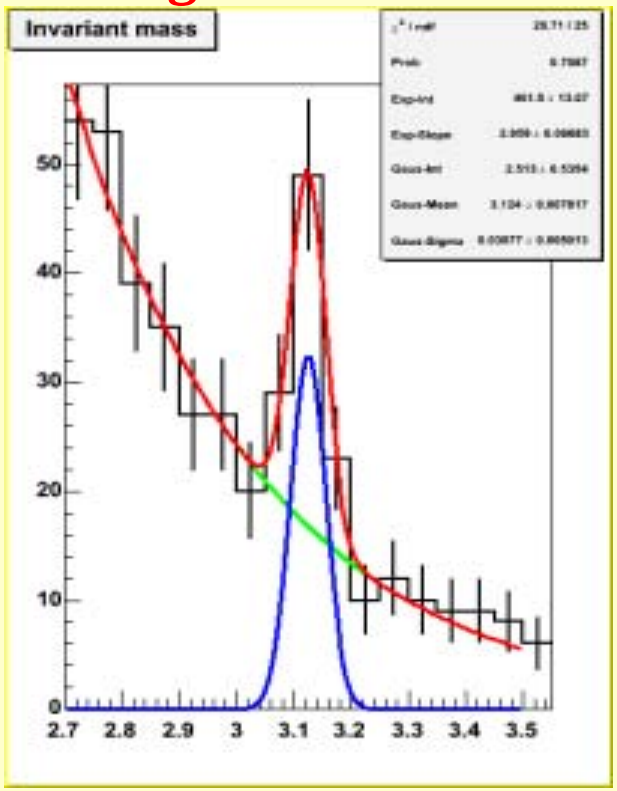
Like sign pairs around J/psi mass region has large statistic fluctuation.
The subtraction method still has large ambiguity.
It is natural to extract J/psi signals by fitting foreground distribution with back ground shape and Gaussian.

Now, the discrepancy of back ground shape between foreground and mixed unlike can be seen.
This is because analyzed data is LVL2 filtered events.
To extract J/psi signals, foreground distribution is fitted with back ground function (exponential) and Gaissian simultaneously.
Check for various fit range were done. (2<M<3.5 and 2.8<M<3.4)

Fit range dependence of $N_{J/\psi}$

Minimum Bias

Range :2.0<M<3.5



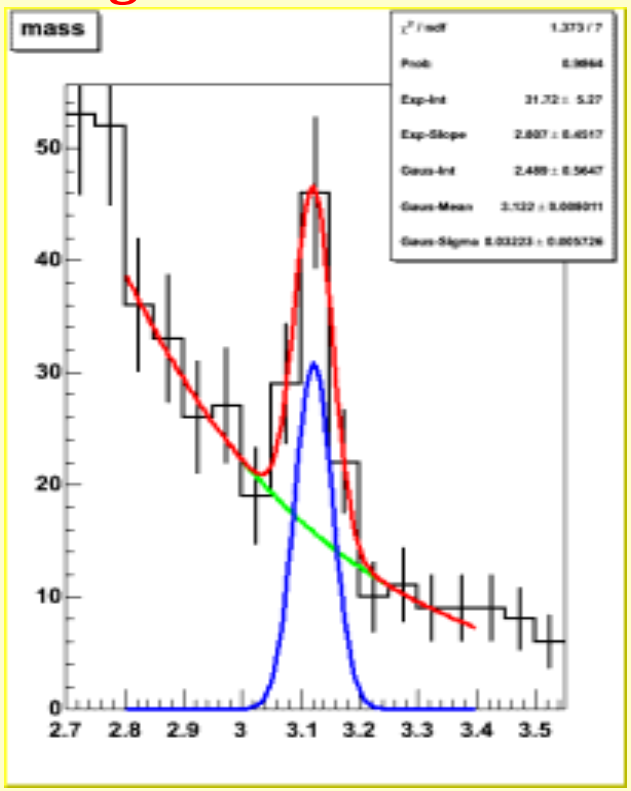
$N_{J/\psi}$ = 50.26 +- 10.72

Mass Center = 3.124 +- 0.0078 GeV

Mass Width = 31.2 +- 5.13 MeV

Minimum Bias

Range :2.8<M<3.4



$N_{J/\psi}$ = 49.78 +- 11.29

Mass Center = 3.122 +- 0.0080 GeV

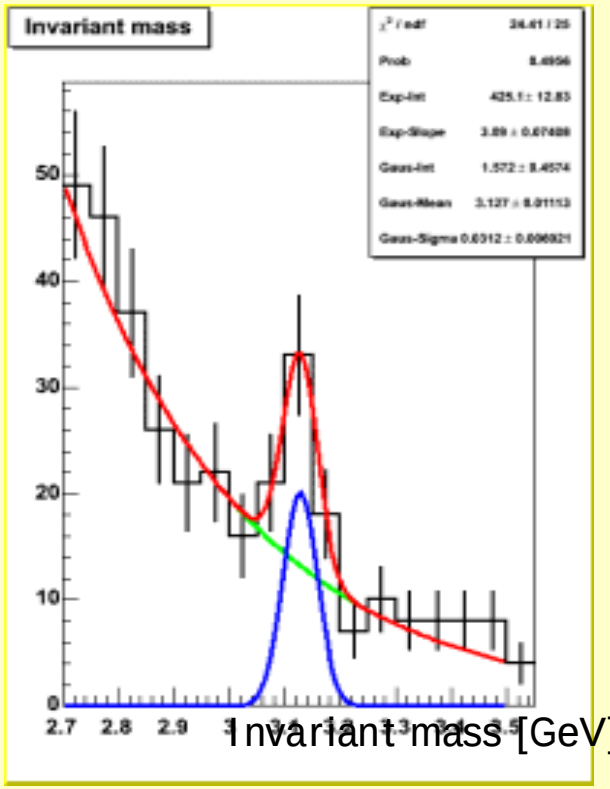
Mass Width = 32.23 +- 5.73 MeV

Stable for fit range.

Fit range dependence of $N_{J/\psi}$

More central,

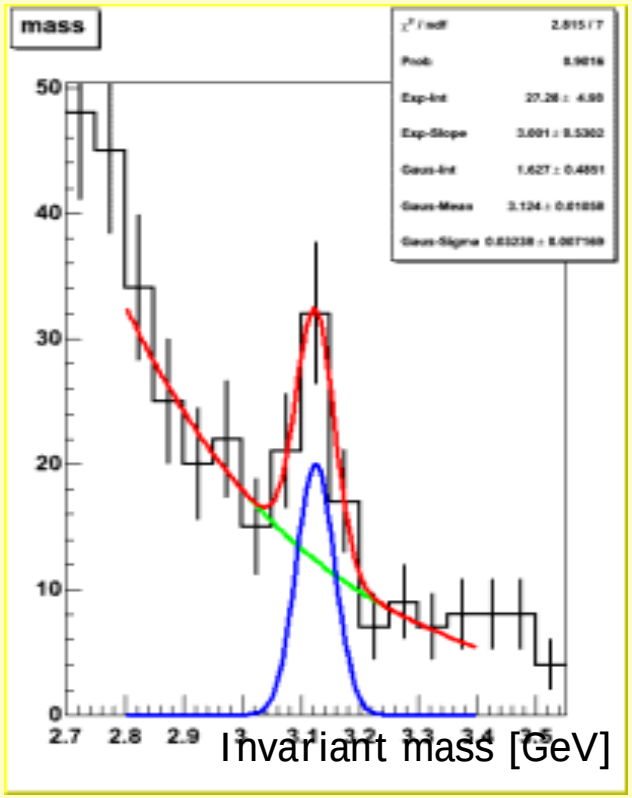
Range:2.0<M<3.5



$N_{J/\psi}$ = 31.44 +- 9.15
Mass Center = 3.127 +- 0.0111 GeV
Mass Width = 31.2 +- 6.92 MeV

More central,

Range:2.8<M<3.4



$N_{J/\psi}$ = 32.54 +- 10.60
Mass Center = 3.124 +- 0.0106 GeV
Mass Width = 33.38 +- 7.17 MeV

Stable for fit range.