Summer Student Programme 2008

Tracking Performance Analysis for the ZEUS-Detector

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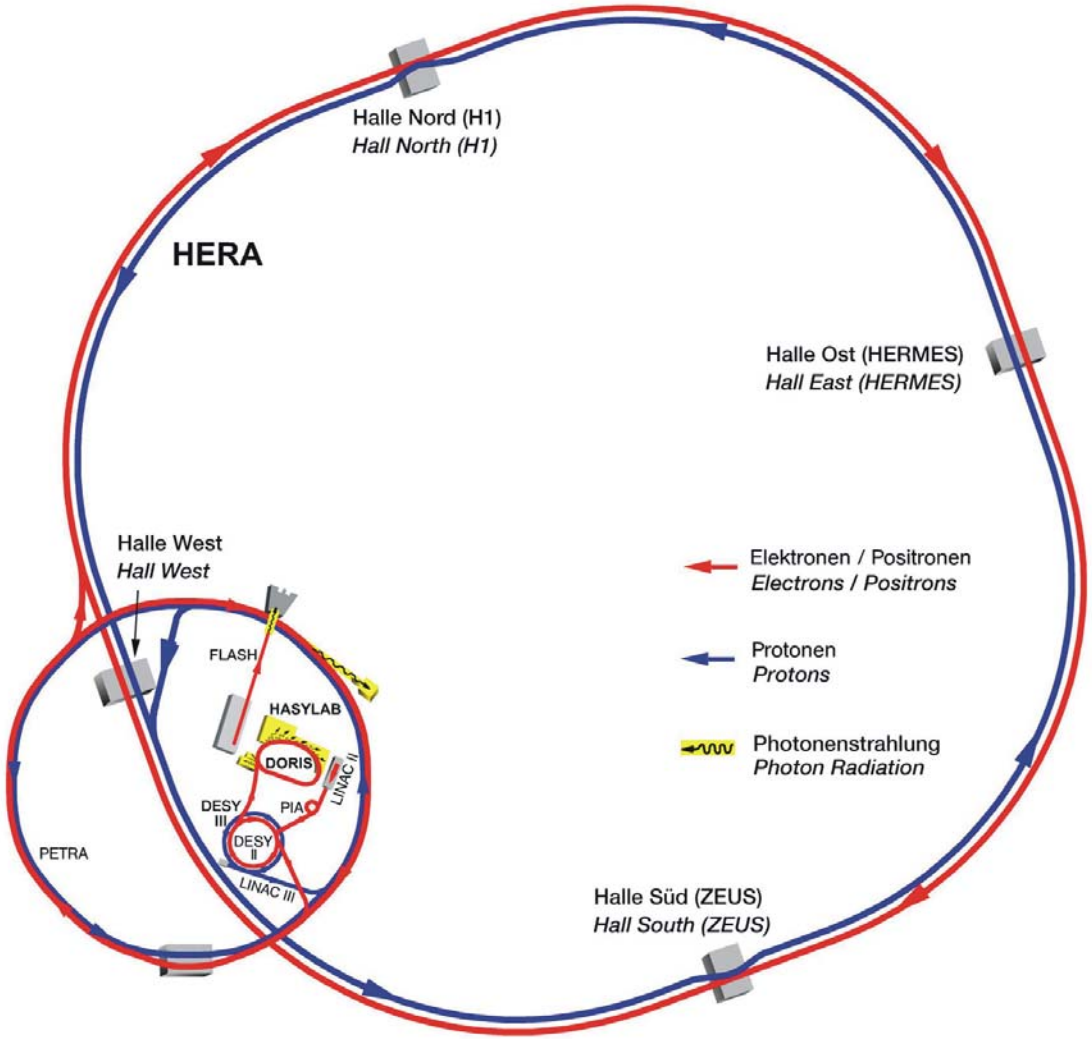
Contents

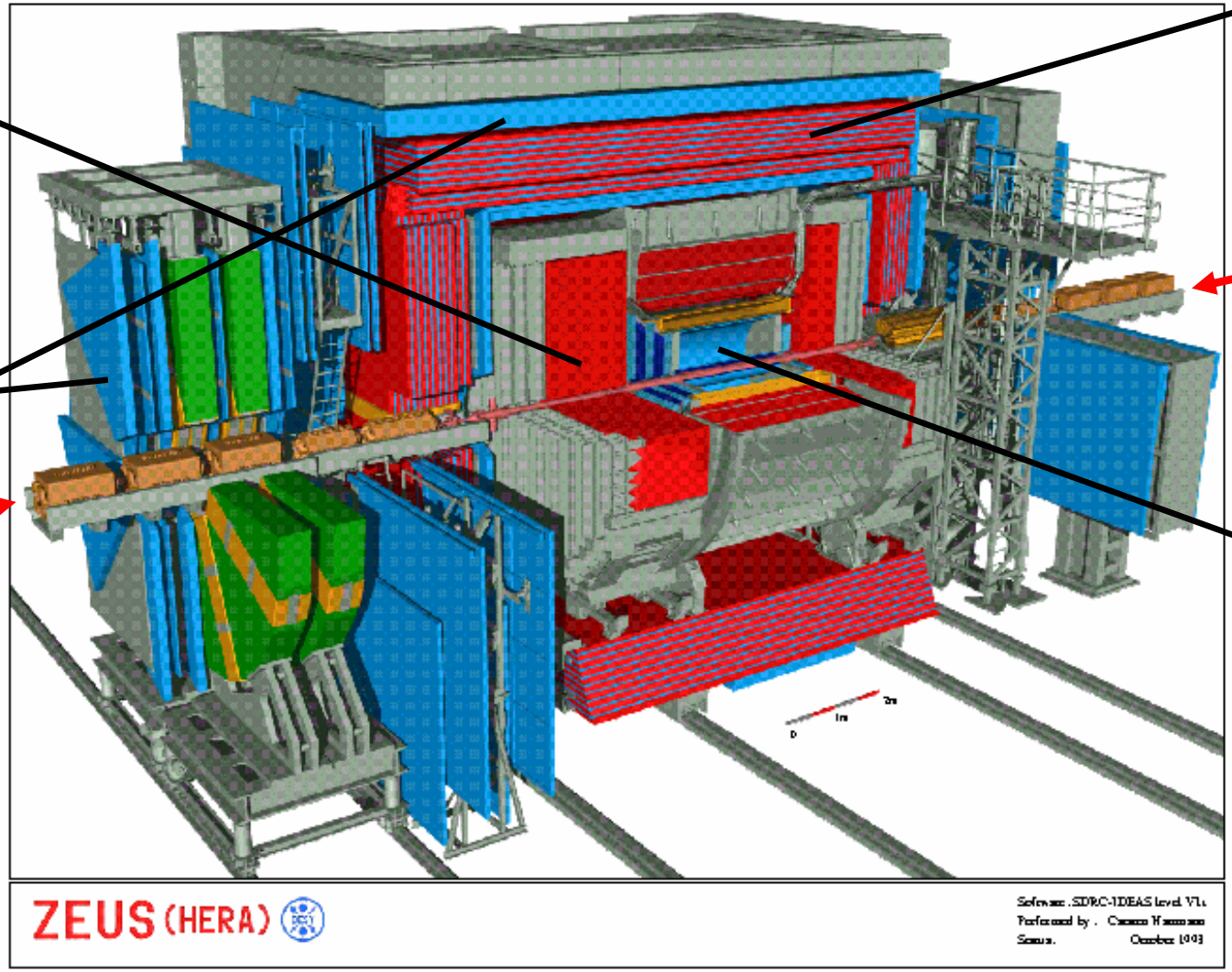
- The HERA Ring
- ZEUS-Detector
- Physics Motivation
- Tracking studies on the J/Ψ
- Tracking studies on the D*
  - The Data
  - The Cuts
  - The Background
  - Results

The Hera Ring



- $e^{+/-}p$-collider (data taking until summer 2007)
- beam energy
  - $e^{+/-}$: 27.5 GeV
  - p: 920 GeV
- 4 experiments:
  - 2 collider
  - 2 fixed target

ZEUS-Detector

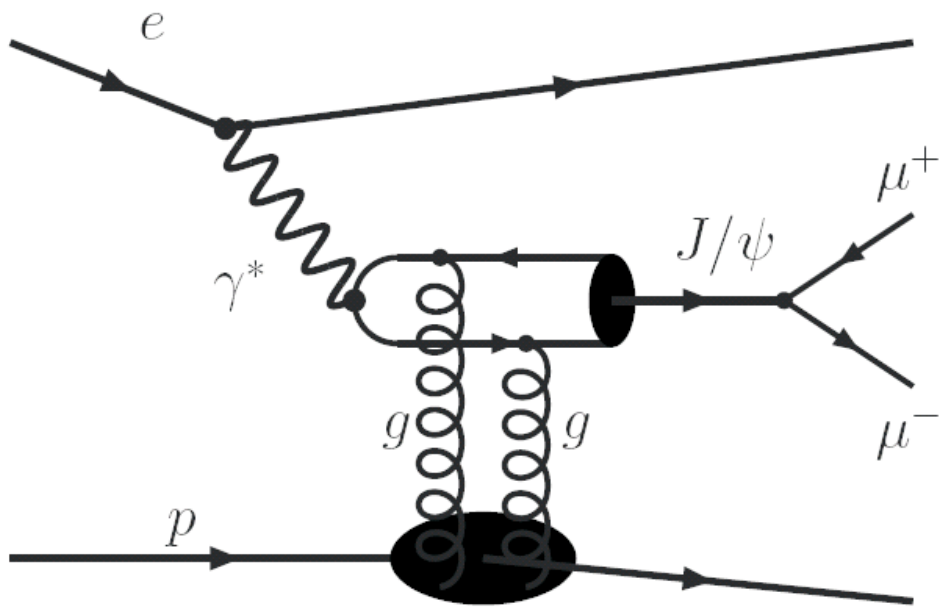


Physics Motivation

- HERA Physics examples:
  - Measurement of proton structure
  - Measurement of heavy quark production
  - …
- Many of these need measurement of particle momenta

→ **need good tracking performance**

Tracking studies on J/Ψ

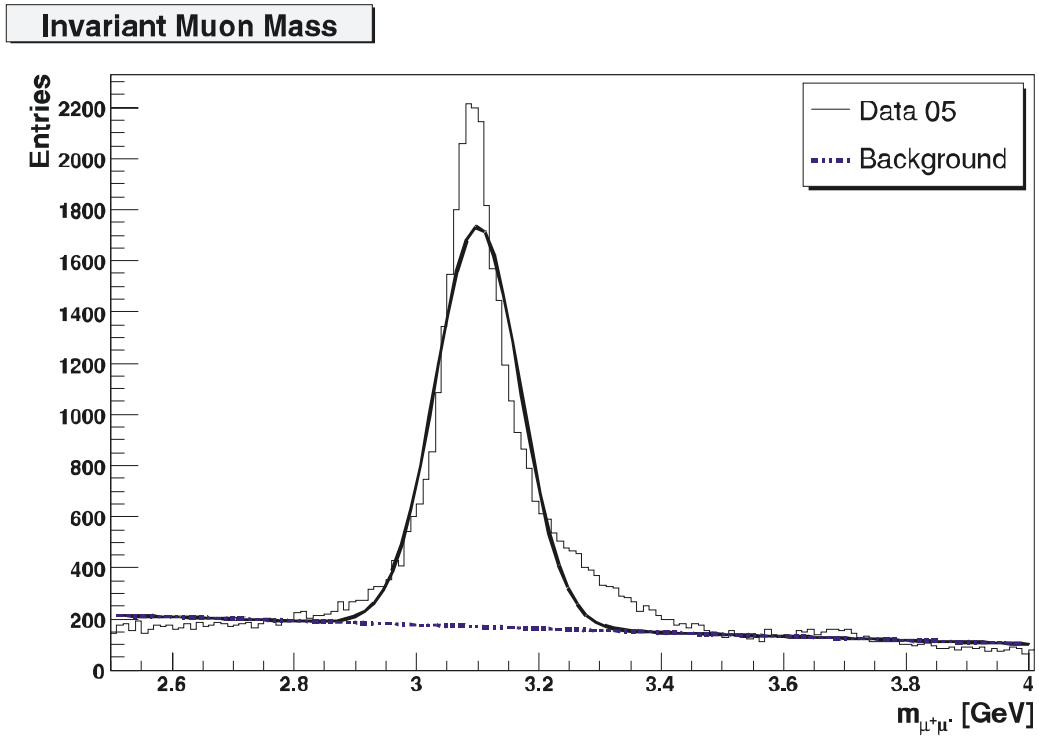


- Reconstruction of the invariant mass of two unlike-signed muons
- Cuts to improve the signal to background ratio

Results I

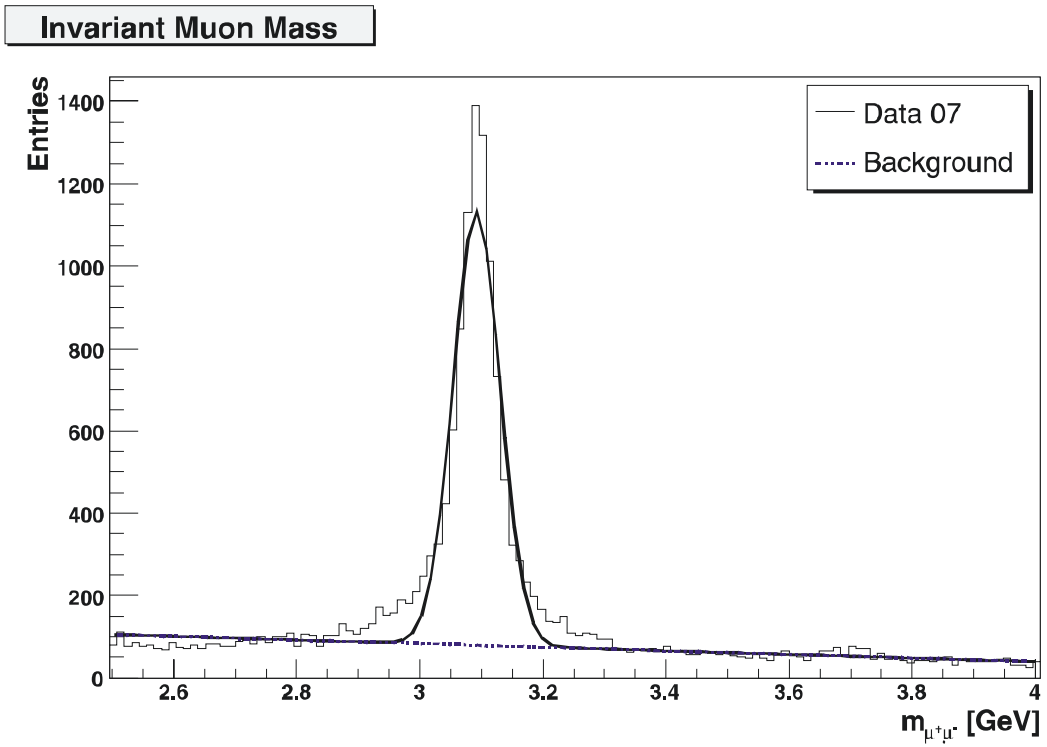
Data 05 (regular tracking)

$\sigma \approx 69$ MeV



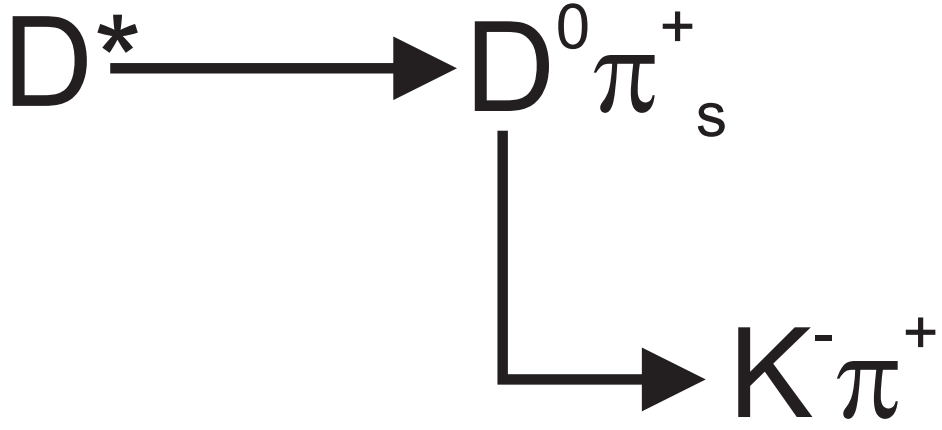
Data 07 (Kalman Filter tracking)

$\sigma \approx 38$ MeV



→ **As observed earlier, Kalman Filter tracking is better than regular tracking**

Tracking studies on D*



- Reconstruct the D*-Peak by plotting $\Delta m = m(K^-\pi^+\pi^+) - m(K^-\pi^+)$
- Cuts to improve the signal to background ratio

Data

- Used Data 06e and 06/07p
- Different processing and tracking
  - 06e: regular tracking
  - 07: kalman filter tracking
- 06e: only events with muon candidates
- 07: all events
- Grand reprocessing → unification of the datasets

The Cuts

- soft cuts:
  - kinematic cuts on the participated particle
    - cuts on the pseudo rapidity
    - cuts on the transverse momentum
  - anti background cuts

The Background

- The distribution of the wrong charge D*-candidates (like-sign pion and kaon from D^0) is similar to the real background

  → **Experimental determination of the background**

- Normalized to side bins

Results I

Data 06e (with μ cand.)

L=55 pb^{-1}

#D*=6856

$$\frac{\#D^*}{L} = 125 \frac{\text{events}}{\text{pb}^{-1}}$$

bg scaling factor: 1.0067

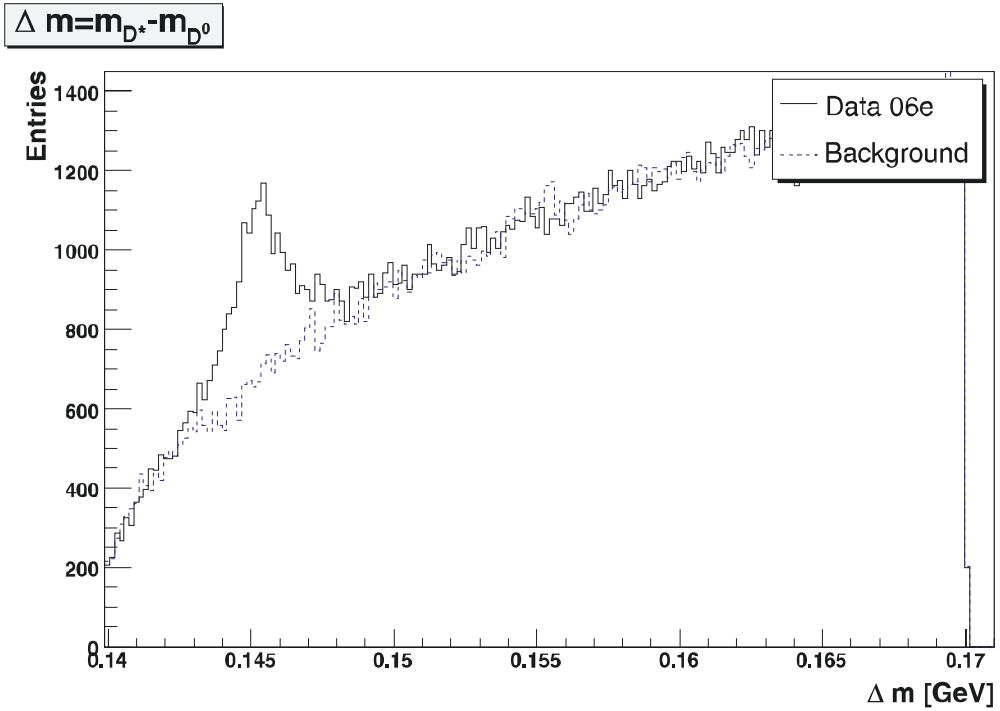
Data 07p (all)

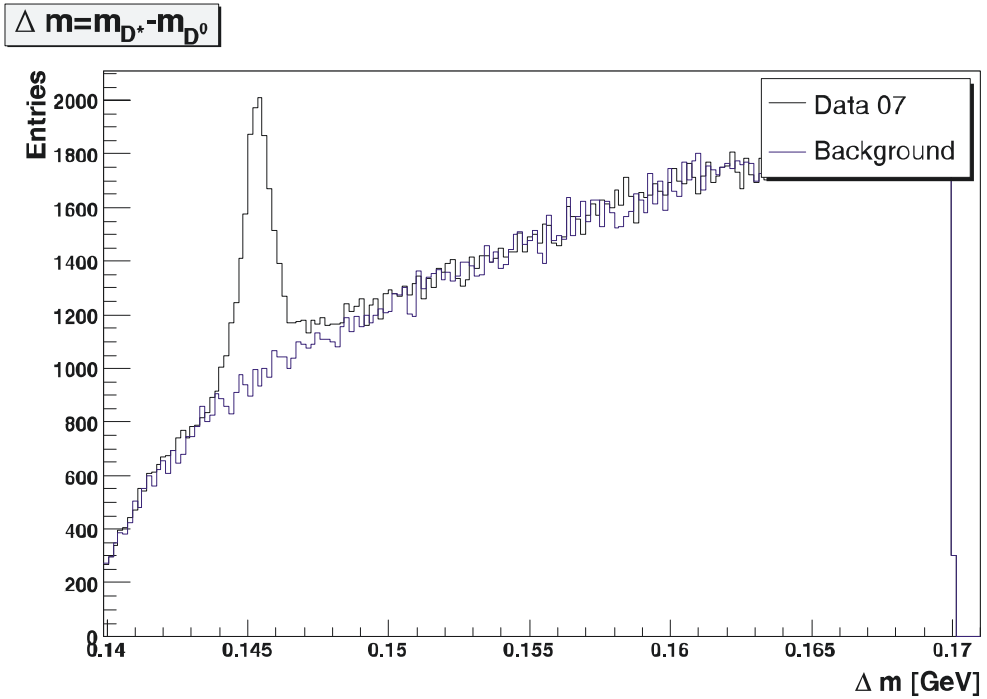
L= 43 pb^{-1}

#D*=9554

$$\frac{\#D^*}{L} = 222 \frac{\text{events}}{\text{pb}^{-1}}$$

bg scaling factor: 1.0072





Results II

- Compare Data:
  - Width: 06/07p is much smaller then 06e

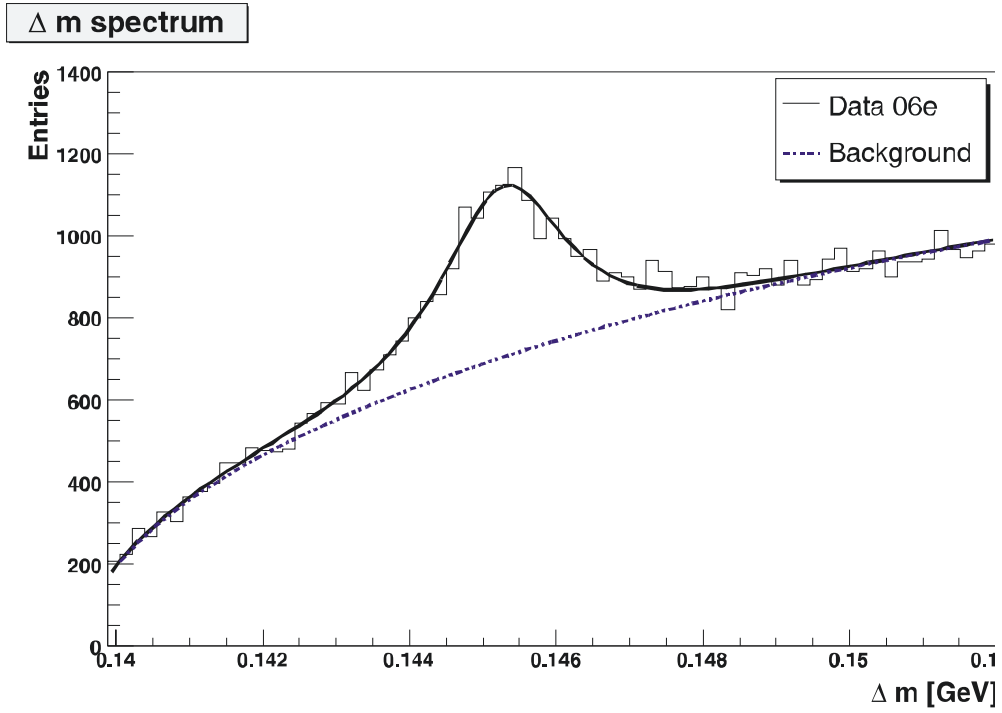
    → **Kalman Filter vs. Regular?**
- to confirm the observation the

  Δm-spectrum can be fitted by a modified Gaussian distribution

Results III

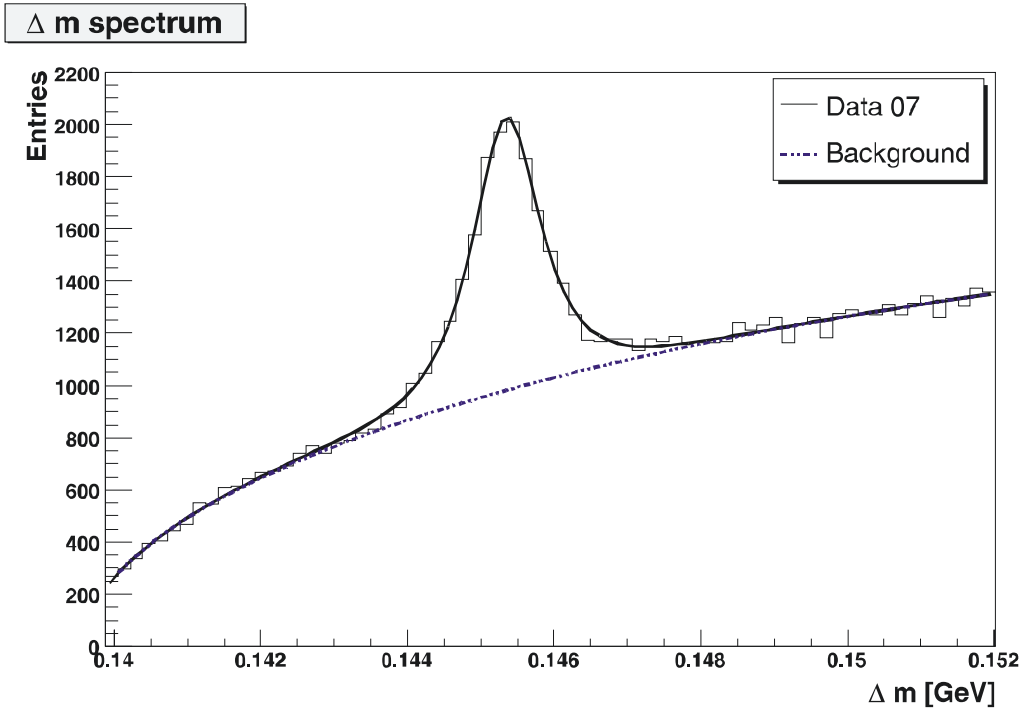
Data 06e

Modified width: 0.80 MeV



Data 07p

Modified width: 0.45 MeV



→ **Kalman Filter tracking is much better than regular tracking**

Conclusion

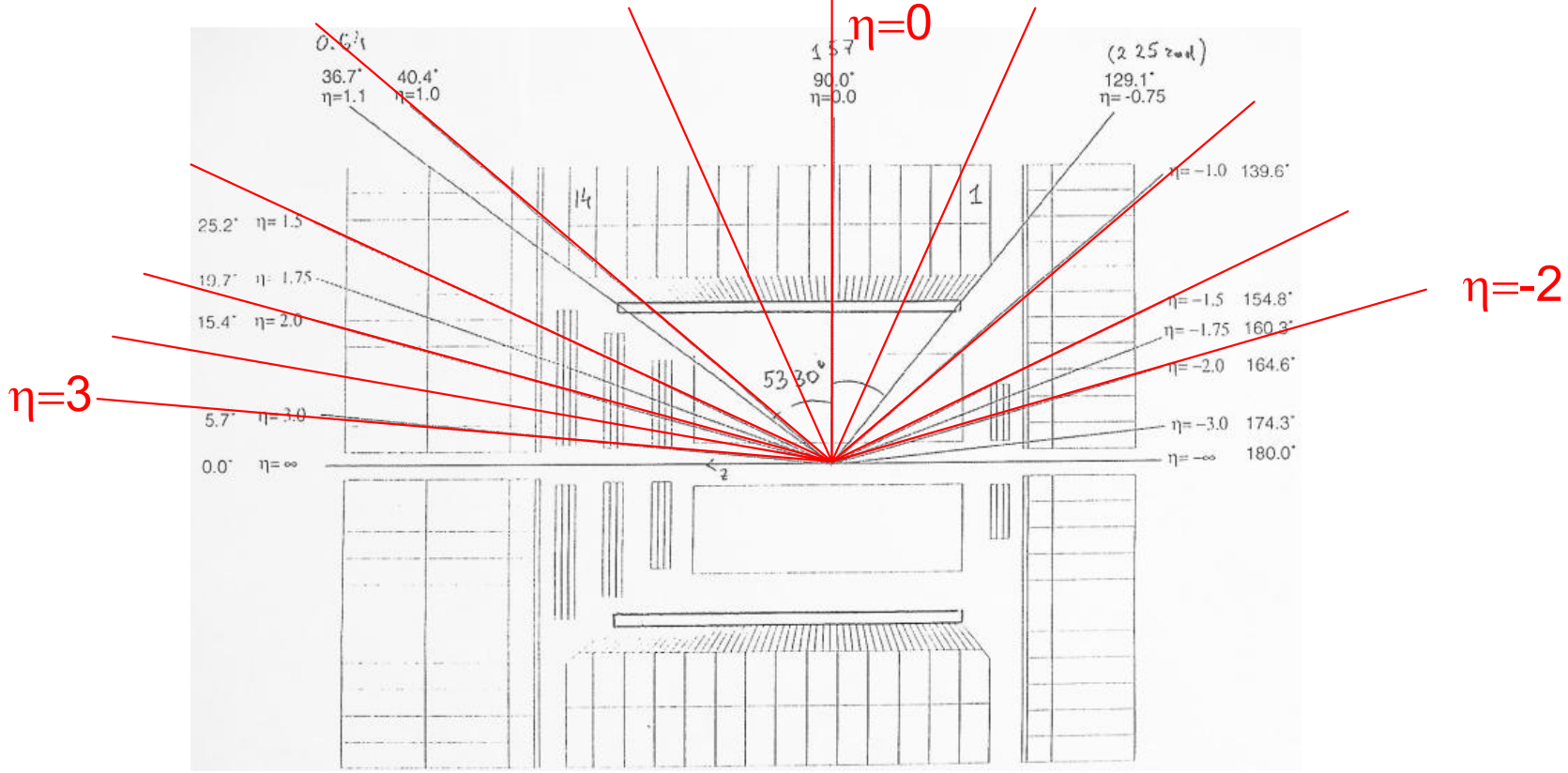
- Studies on J/Ψ and D*

→ **Kalman Filter tracking is much better than regular tracking, nearly by a factor of 2**

→ **One of the benchmarks for upcoming Grand Reprocessing**

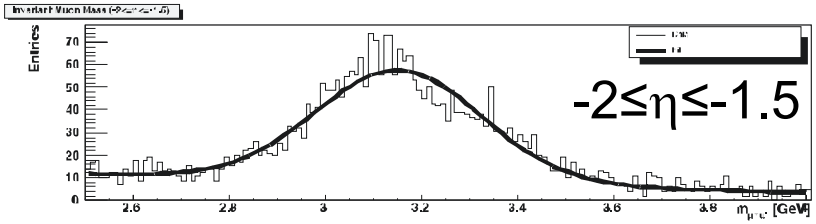
Backup slides

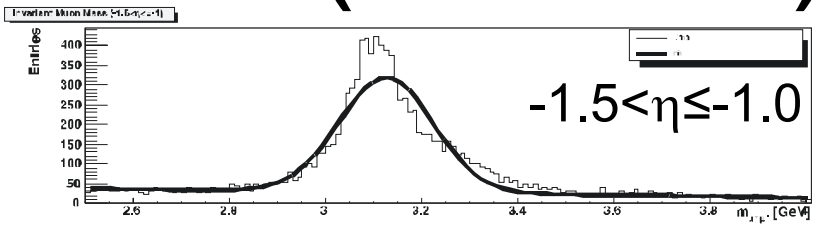
Detector Resolution I

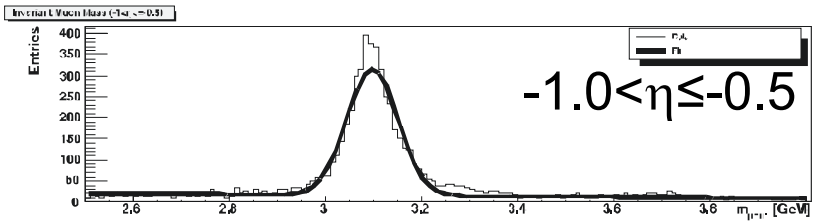


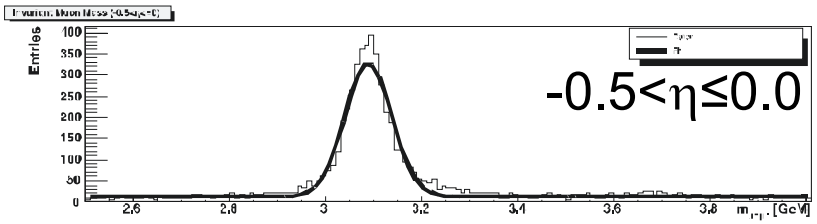
- Divide the η range for the first muon between η=-2 and η=3 into pieces of Δη=0.5

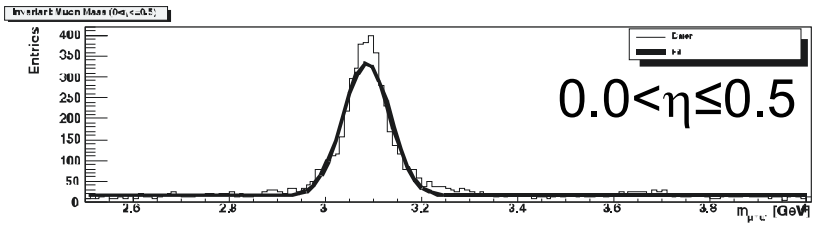
Detector resolution II (data 05)

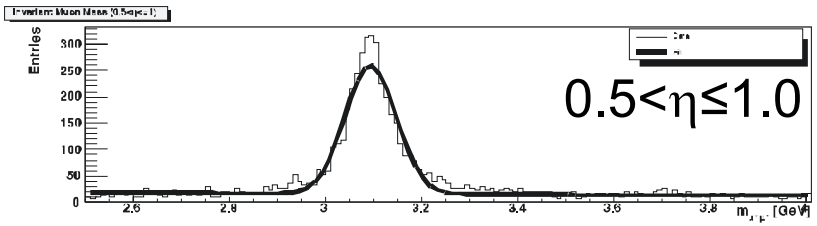


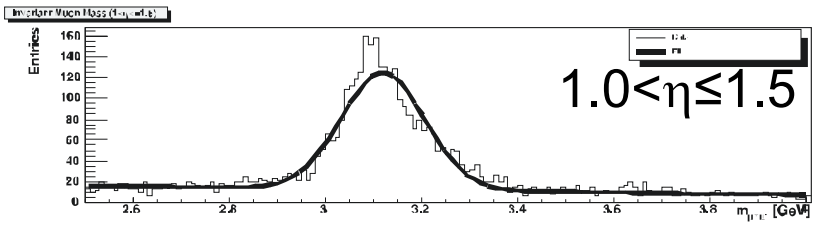


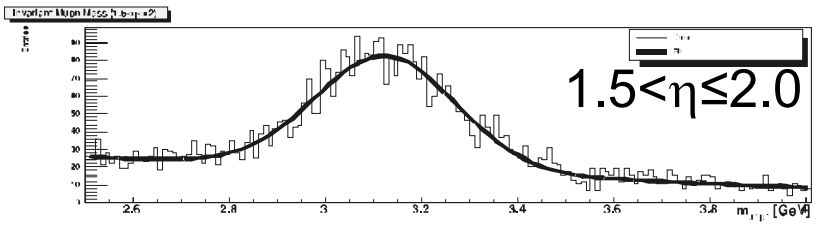


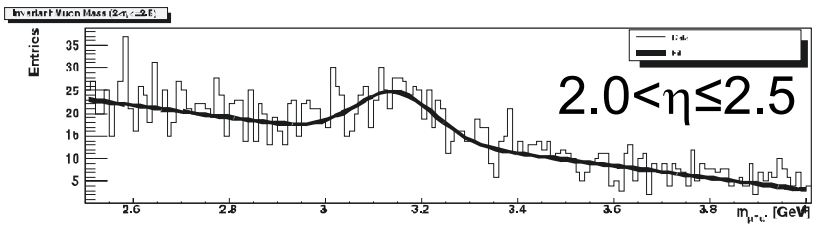


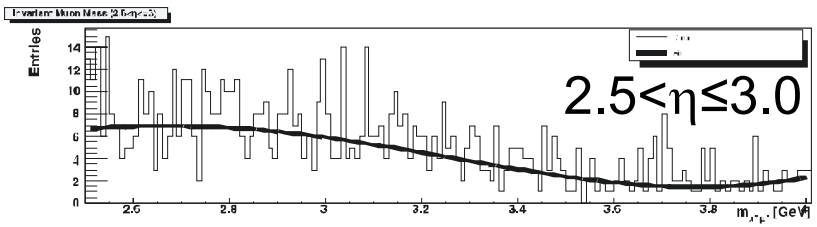




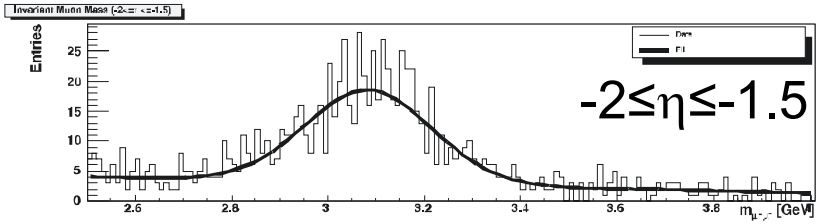


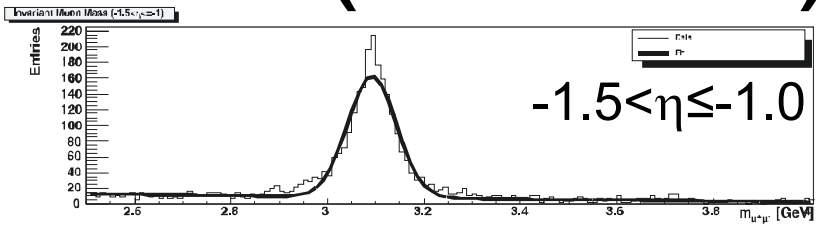


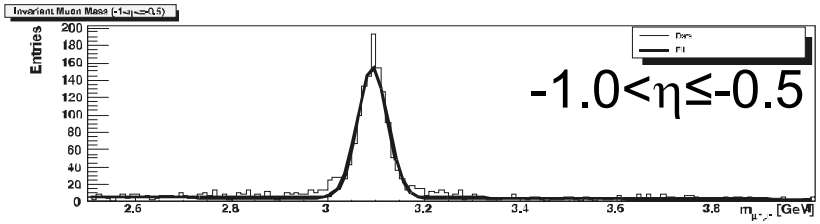


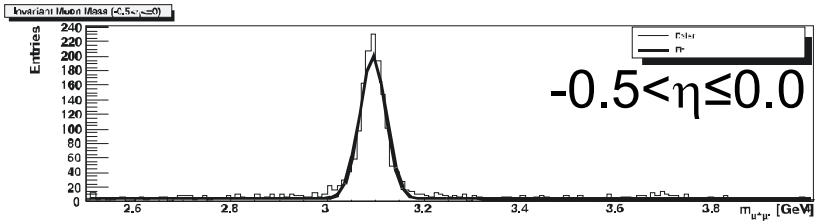


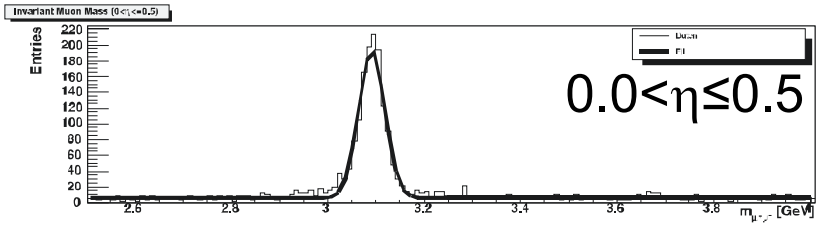
Detector resolution III (data 07)

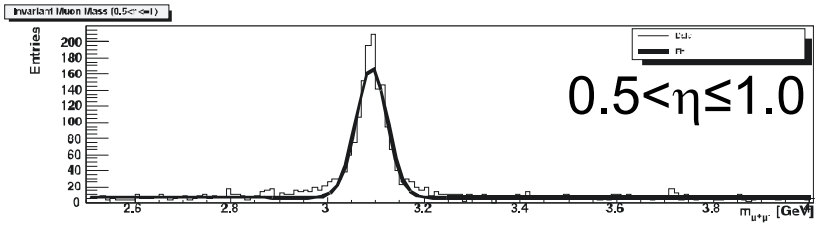


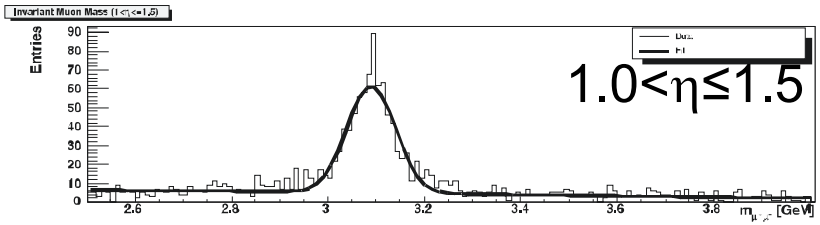


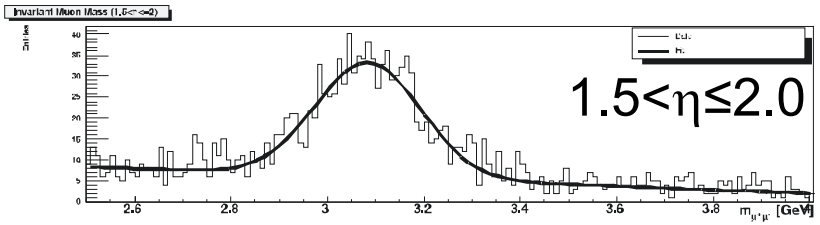


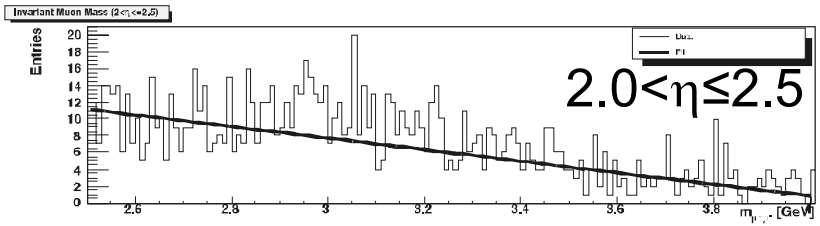


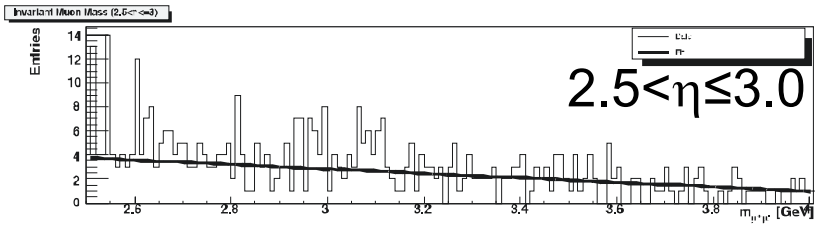




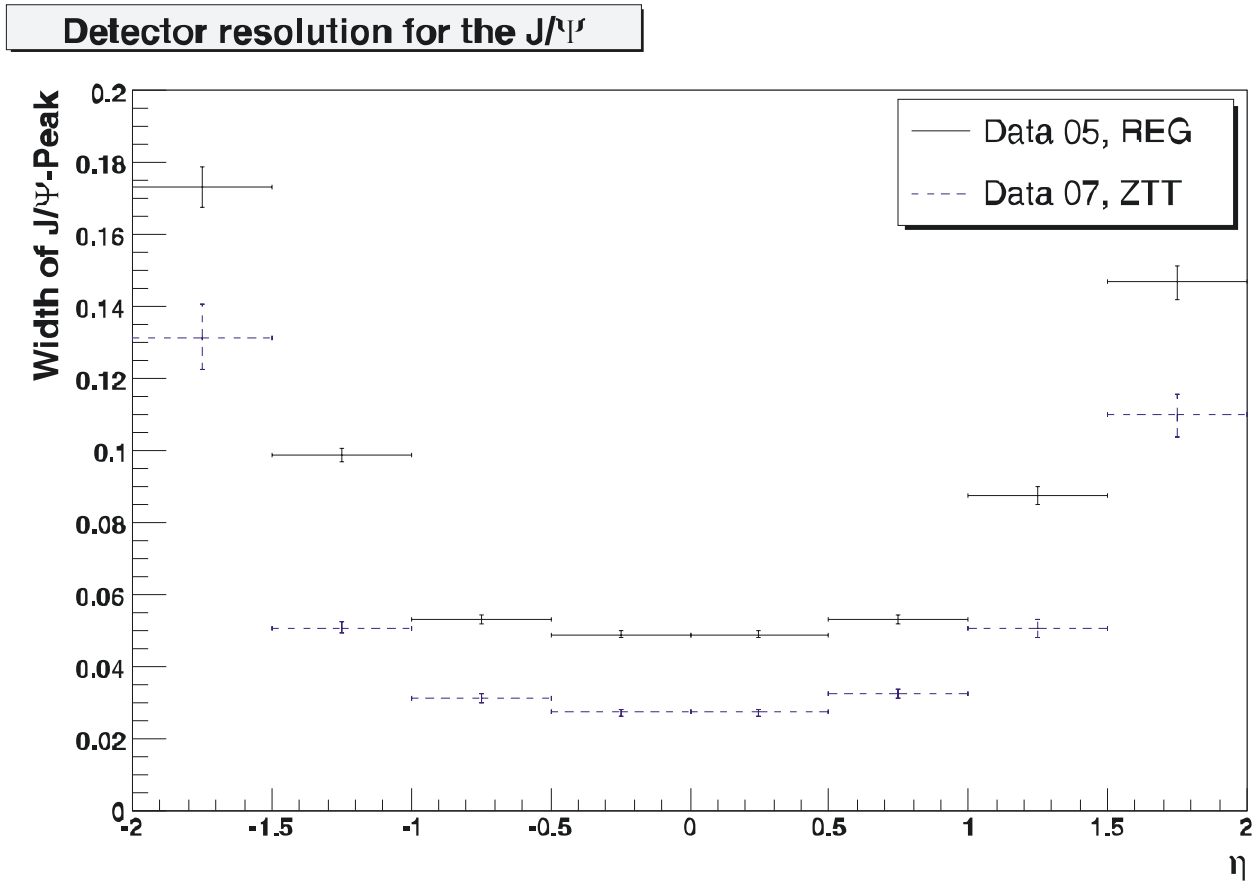








Detector Resolution: Conclusion



- 07 has at each point a better resolution, nearly a factor of 2