Results on leptonic probes from NA50

NA50 Collaboration

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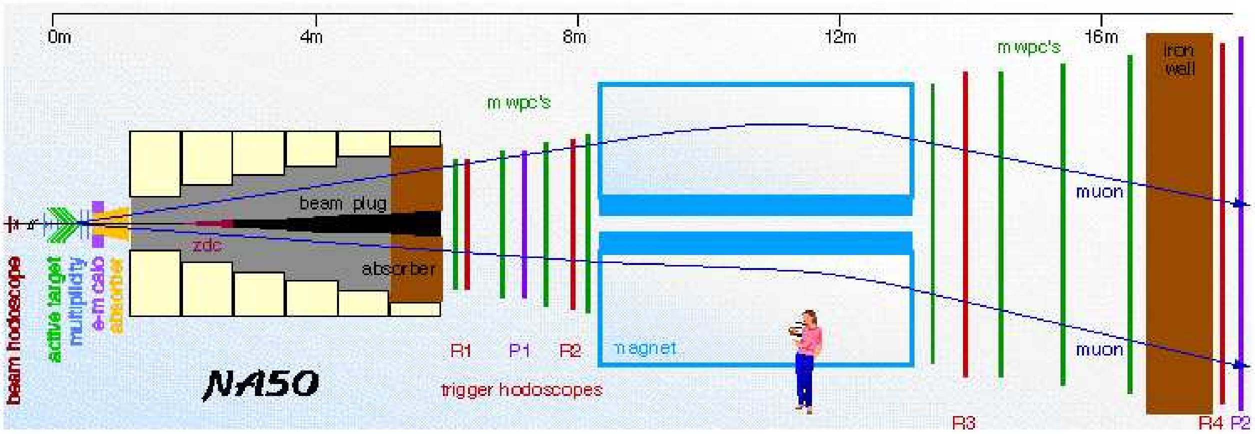

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The NA50 Collaboration

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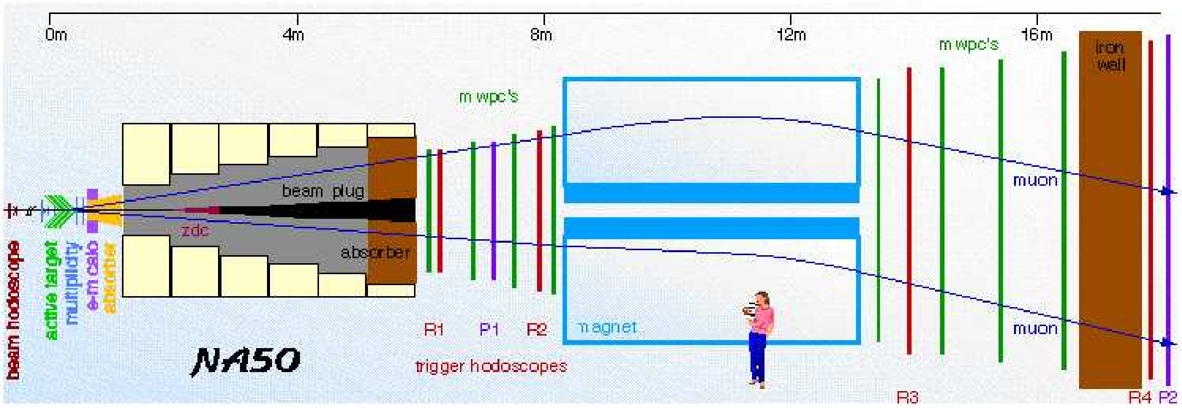
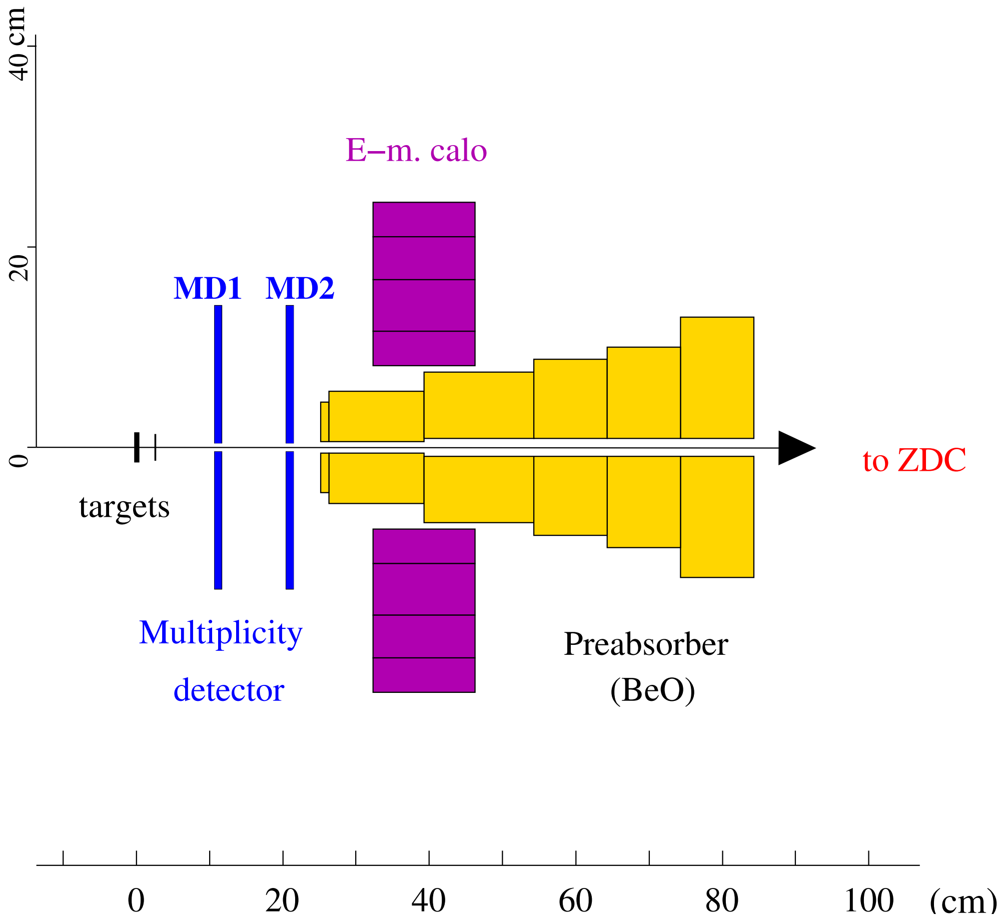
Outline of the presentation

- **Introduction**
  - ✎ Published NA50 results on charmonium
  - ✎ Goals and tools of the year 2000 Pb-Pb run
  - ✎ Determination of normal absorption from new p-A data
  - ✎ The standard analysis method: $\sigma(\mathrm{J}/\psi)/\sigma(\mathrm{Drell-Yan})$
- **Results from year 2000 Pb-Pb run**
  - ✎ PRELIMINARY $\sigma(\mathrm{J}/\psi)/\sigma(\mathrm{DY})(2.9-4.5)$ vs. transverse energy E_T
  - ✎ PRELIMINARY $\sigma(\mathrm{J}/\psi)/\sigma(\mathrm{DY})(2.9-4.5)$ vs. forward energy E_{ZDC}
  - ✎ Comparison with published results
- **Summary**

The NA50 Dimuon Spectrometer



dimuon rapidity ($0 < y_{cm} < 1$)**, polar angle** ($-0.5 < \cos\theta_{CS} < 0.5$)

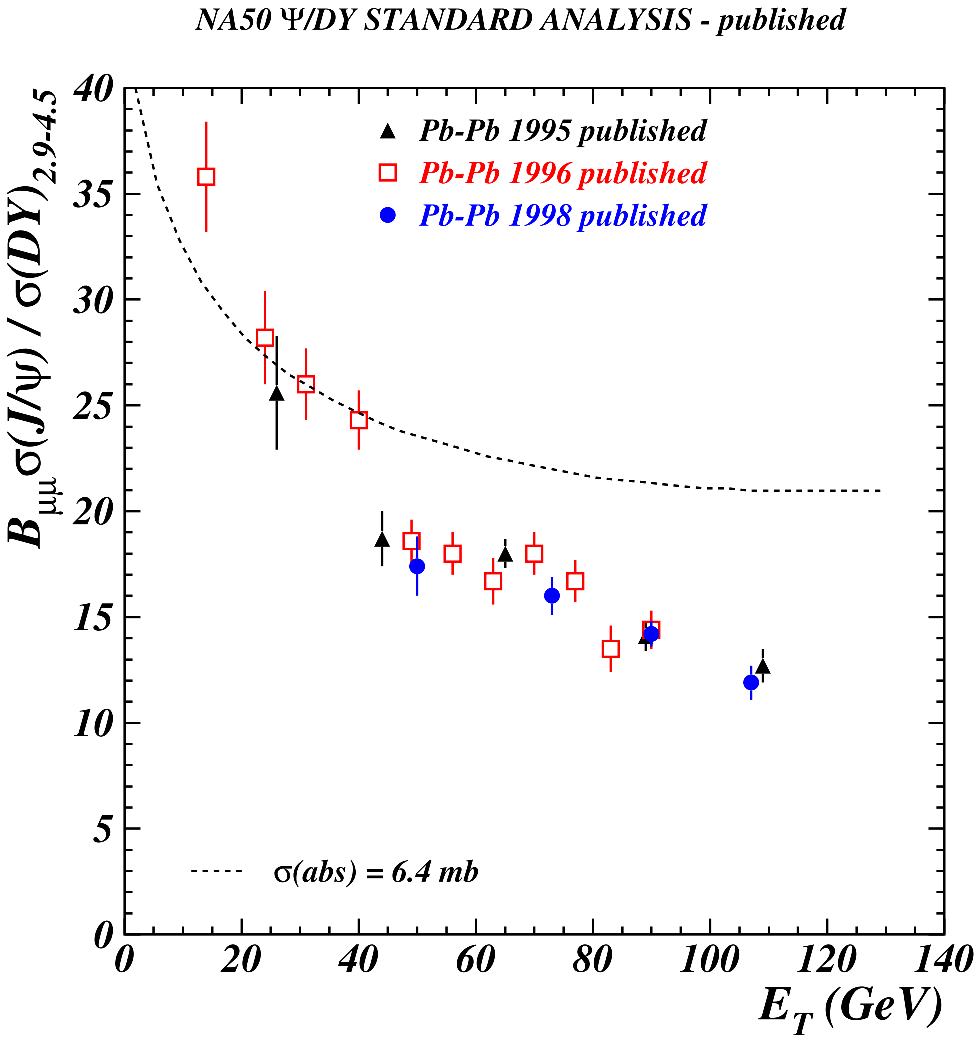


Centrality detectors: **E.M. Calo.** ($1.1 < \eta < 2.3$)

Multiplicity Det. ($1.9 < \eta < 4.2$) **Zero Degree Calo.** ($\eta > 6.3$)

Beam Hodoscope, B.H. Interaction det., Big Anti Halo det.

NA50 published results



- Threshold effect at $E_T \simeq 40$ GeV, no saturation for central collisions
- Analysis of peripheral Pb-Pb collisions limited by Pb-air contamination ➪ are they really compatible with lighter systems ?
- Comparison with ordinary nuclear absorption also limited by low statistics of NA38 p-A and S-U results ($\sigma(abs) = 6.4 \pm 0.8$ mb)

Goals and tools of the 2000 run

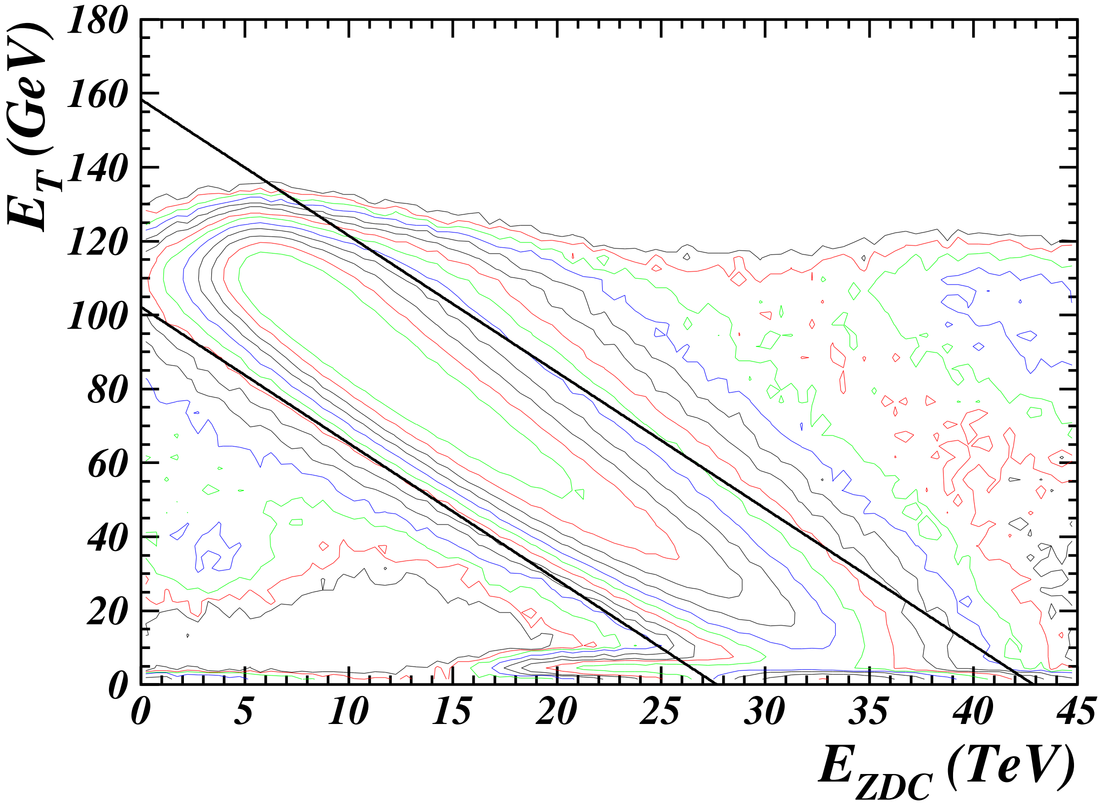
1. Investigate peripheral Pb-Pb interactions in improved experimental conditions
2. Check behaviour of anomalous J/ψ suppression against normal absorption, as determined by high statistics p-A data

- Target region under vacuum up to preabsorber
- New pileup rejection method
- New primary interaction location method
- More accurate measurement of p-A charmonium production for reference

Pileup rejection ⇨ E_T-E_{ZDC}

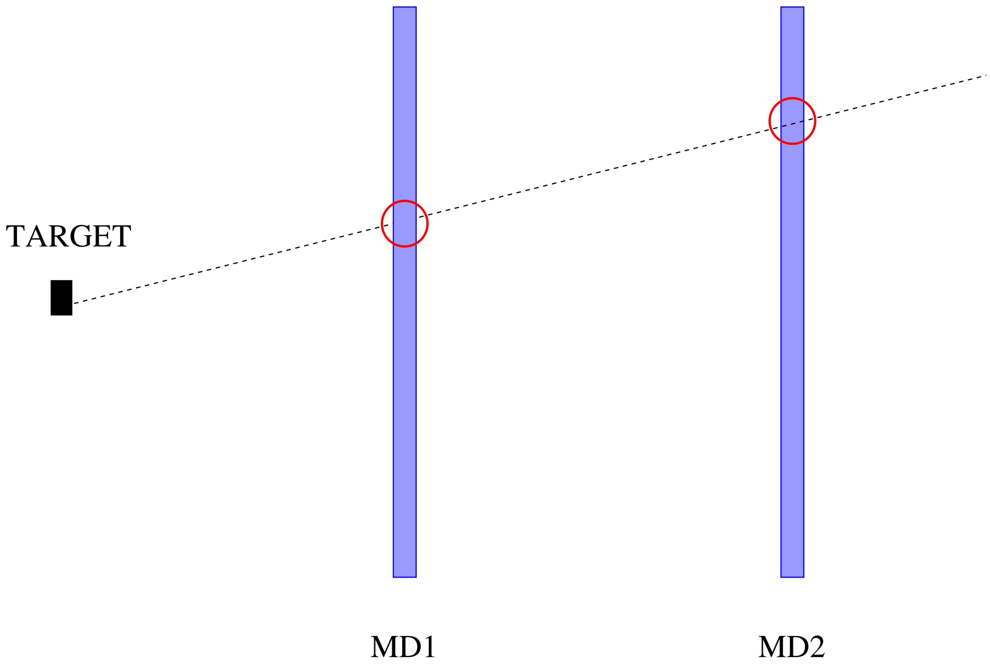
- reject parasitic interactions of incident ion in Beam Hodoscope

- reject double interactions by temporal analysis of signal in E.M. calorimeter



- reject residual pileup based on diagonal band cut in the E_T-E_{ZDC} correlation plane

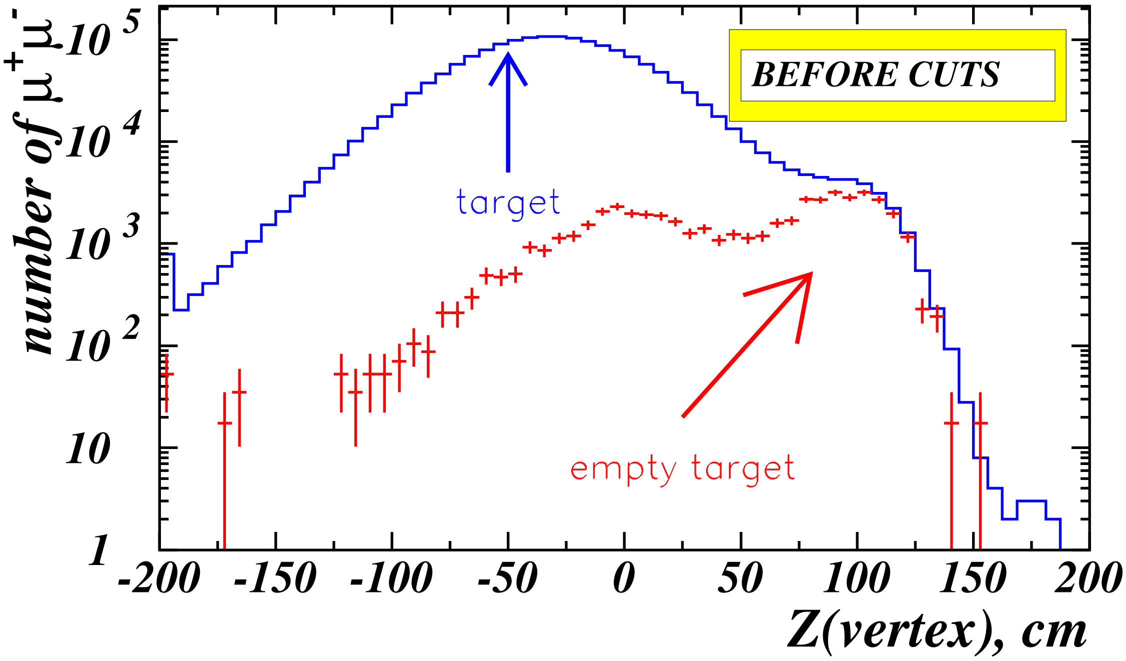
Primary interaction location

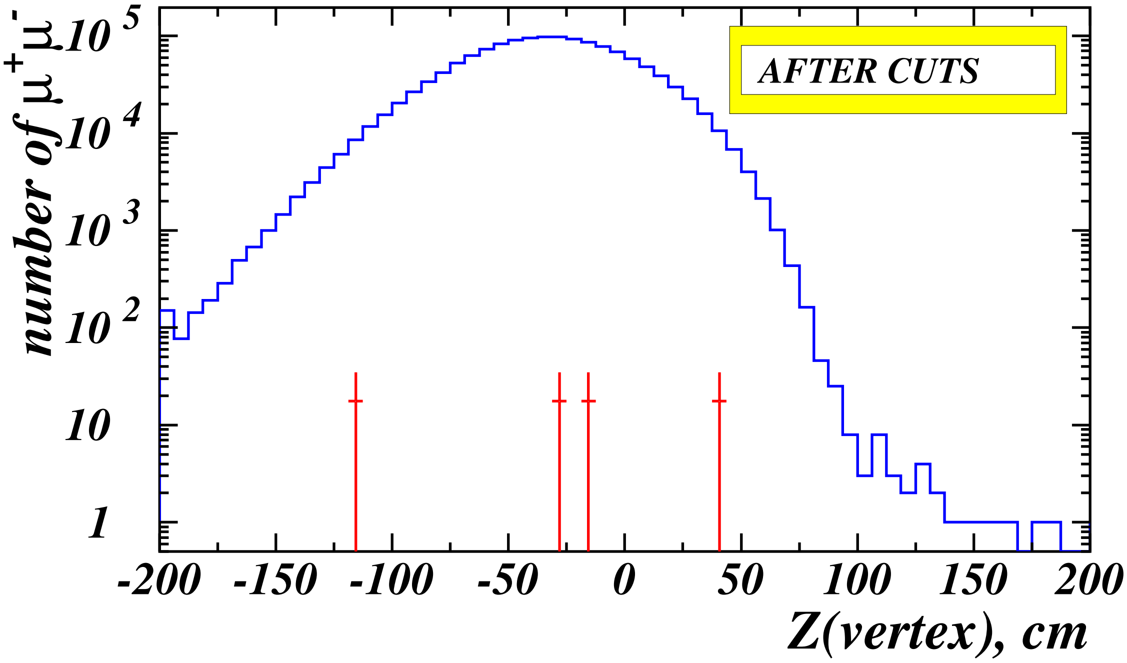


- combine hits on MD1 and MD2 ➪ tracklets
- count tracklets from target position
- count tracklets from alternative positions
- **cut on number of tracklets ➪ select primary interaction location**

☞ works for $E_T > 3$ GeV, full efficiency for $E_T > 15$ GeV

Effect of target cuts: Z_{VERTEX}

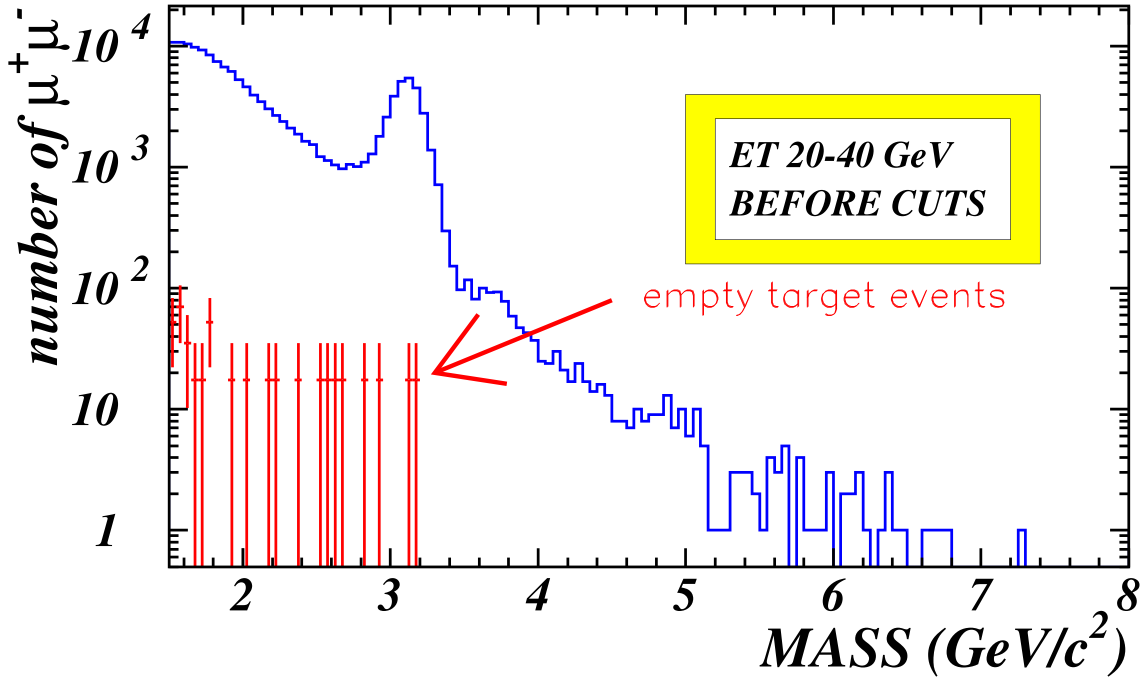


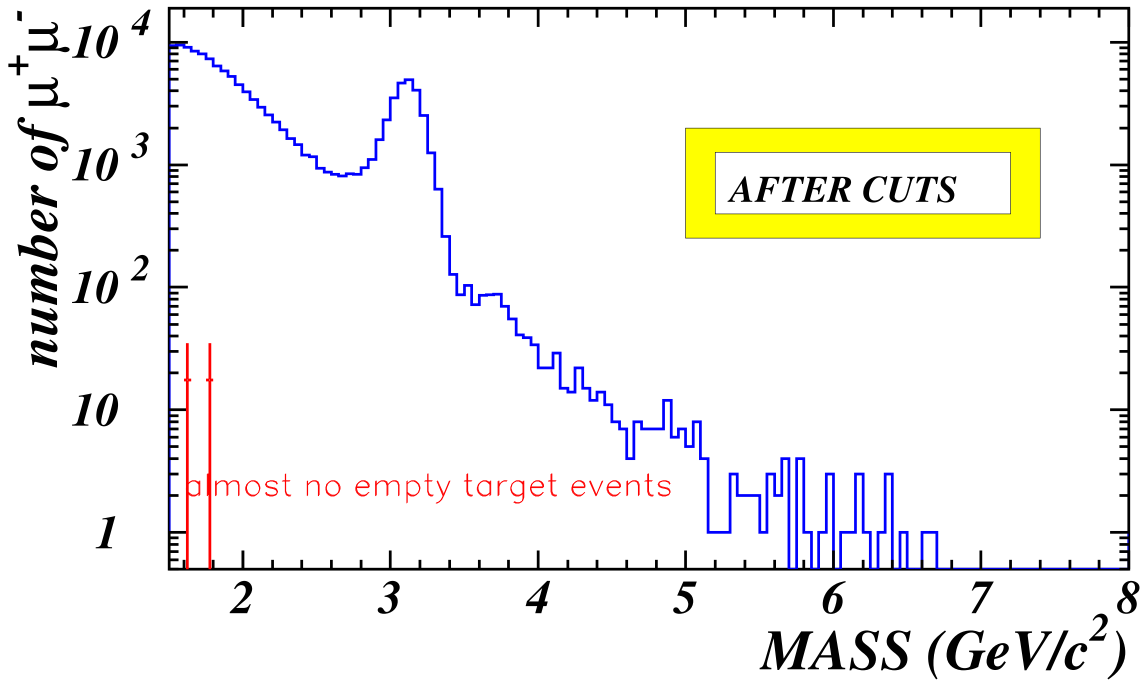


Z_{VERTEX} = Z of closest approach between the two muons

dimuons not coming from the target are rejected

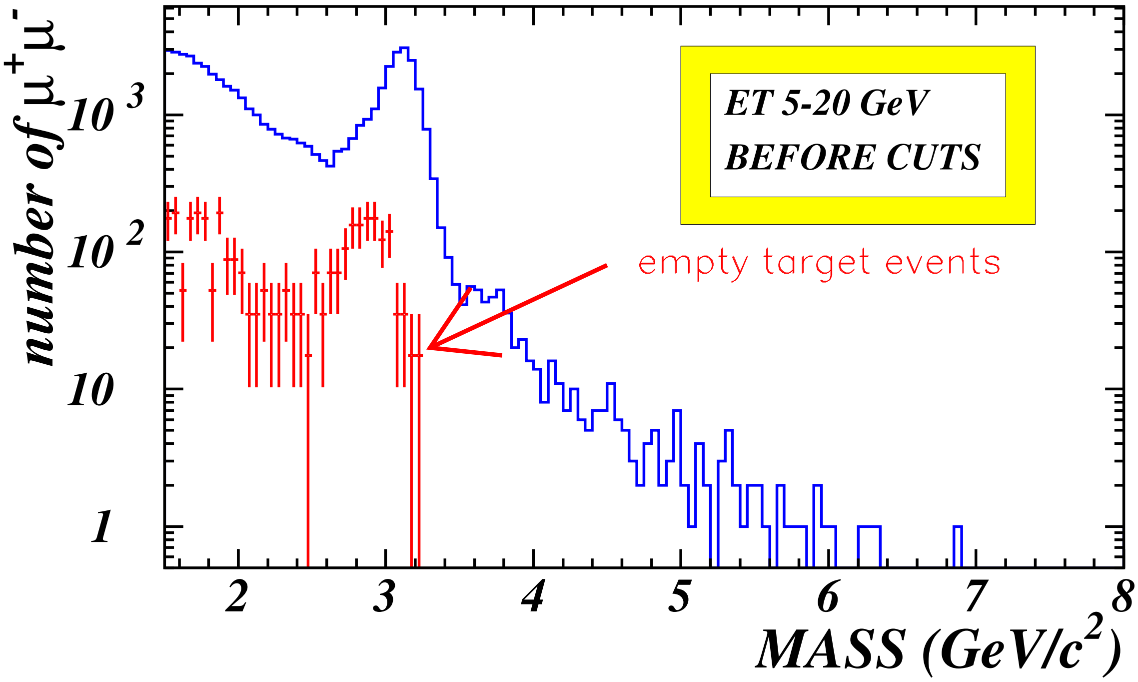
Effect of cuts: Mass spectrum (I)

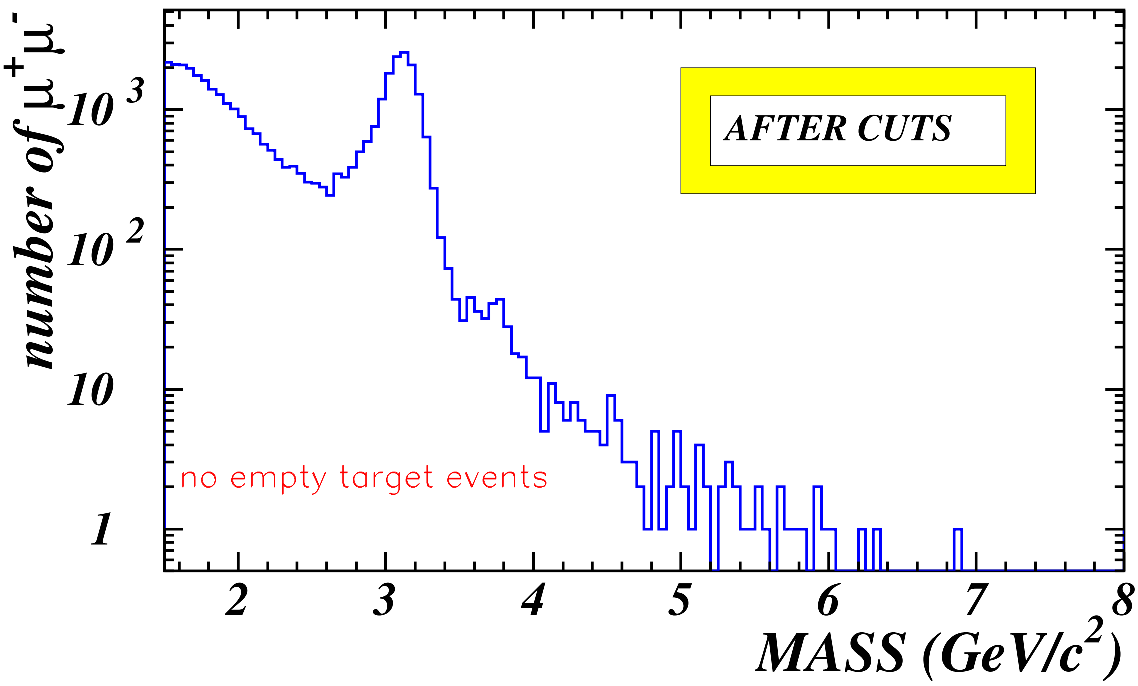




$E_T > 20$ **GeV: empty target contamination already low**

Effect of cuts: Mass spectrum (II)



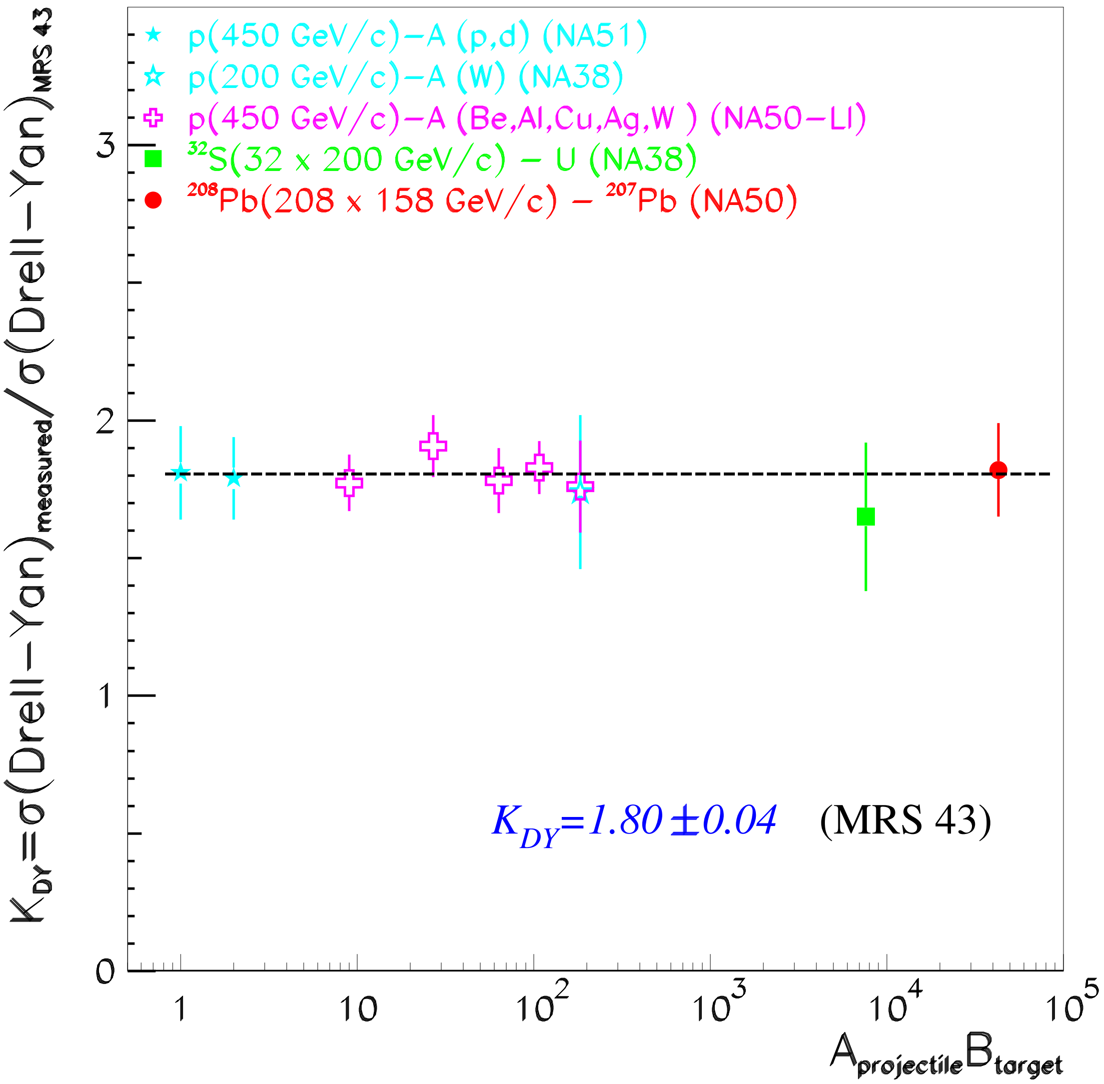


low E_T: contamination at $M < M_{J/\psi}$ is removed by target cuts

The standard analysis method

- Fit to $\mu^+\mu^+$, $\mu^-\mu^-$ mass spectra to determine combinatorial background
- Fit to $\mu^+\mu^-$ mass spectra with four contributions: J/ψ, ψ', Drell-Yan and Open Charm
- Extract J/ψ and Drell-Yan yields
- Advantages:
  - ratio of dimuon processes
    ➪ efficiencies cancel out (same trigger)
  - absolute normalization
    ➪ straigthforward comparison to normal absorption
- Price to pay:
  - low statistics for high mass Drell-Yan

The Drell-Yan reference

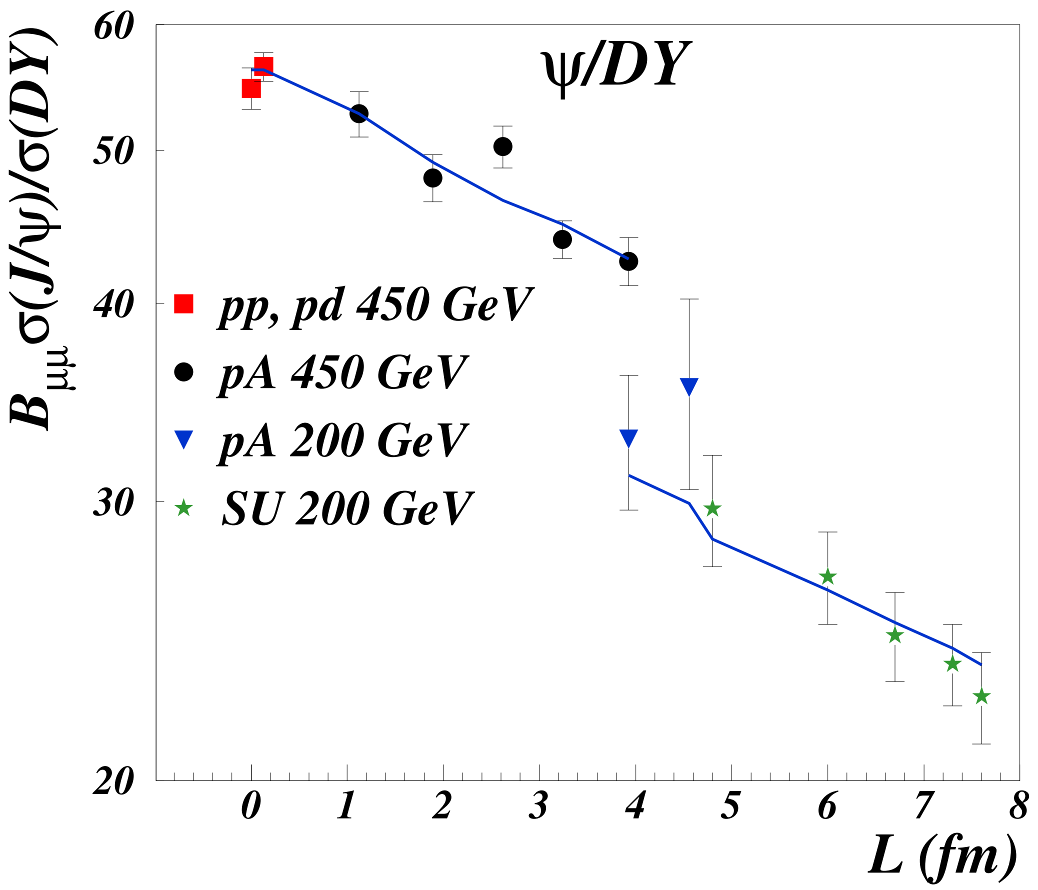


The Drell-Yan yield is proportional to the number of nucleon-nucleon collisions from p-p up to Pb-Pb:

➪ **good normalization for the J/ψ yield**

➪ **centrality dependence of the cross-section ratio $\sigma(\mathbf{J}/\psi)/\sigma(\mathbf{DY})(\mathbf{2.9}-\mathbf{4.5})$ in Pb-Pb must be compared with precise measurement of same ratio in lighter systems**

Normal absorption of J/ψ

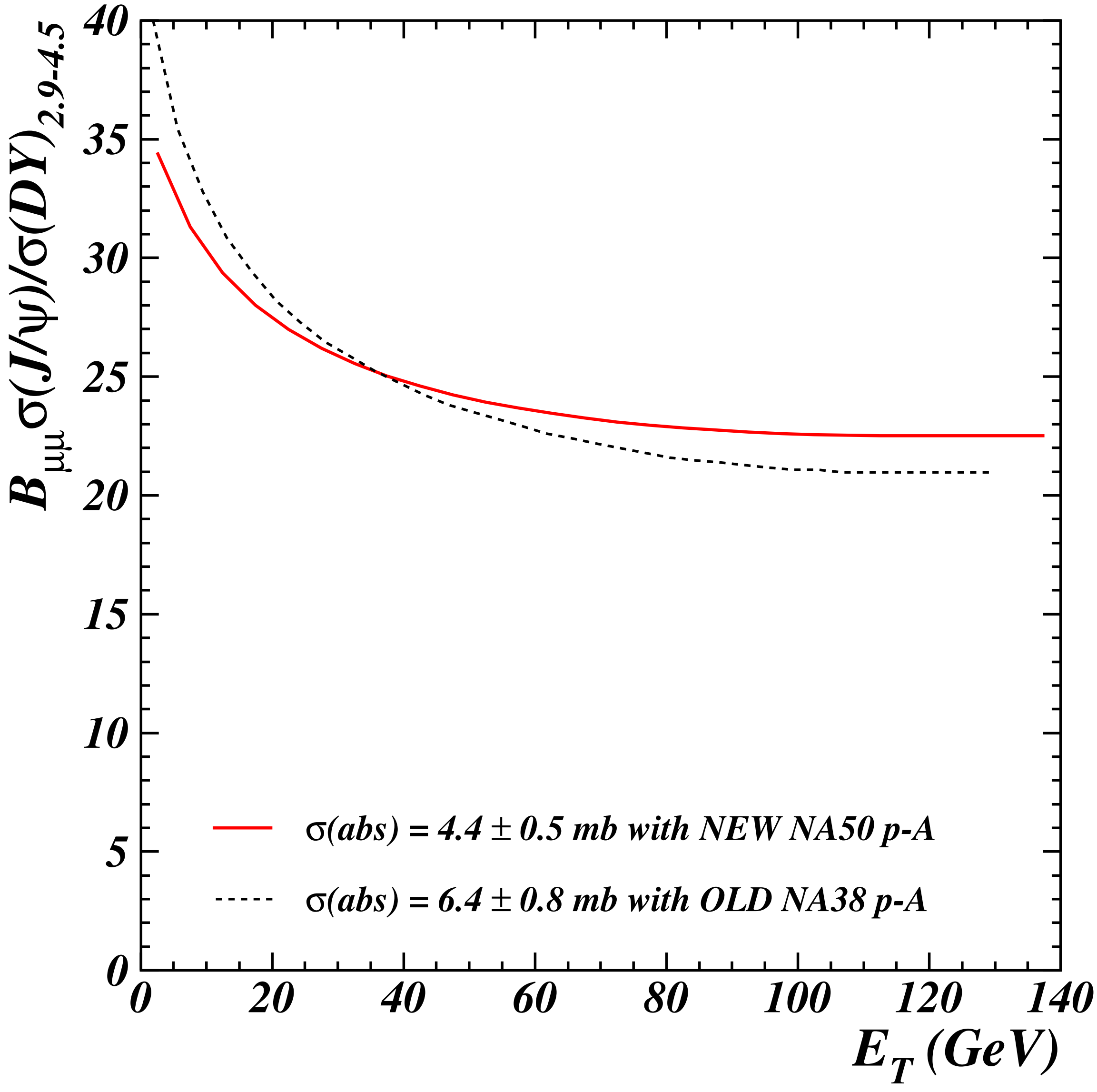


- **Glauber model fit ➪ S-U compatible with p-A ➪ simultaneous fit with common absorption cross section is allowed**
- **From new NA50 p-A data + previous data:**

$$\boldsymbol{\sigma_{abs} = 4.4 \pm 0.5 \text{ mb}}$$

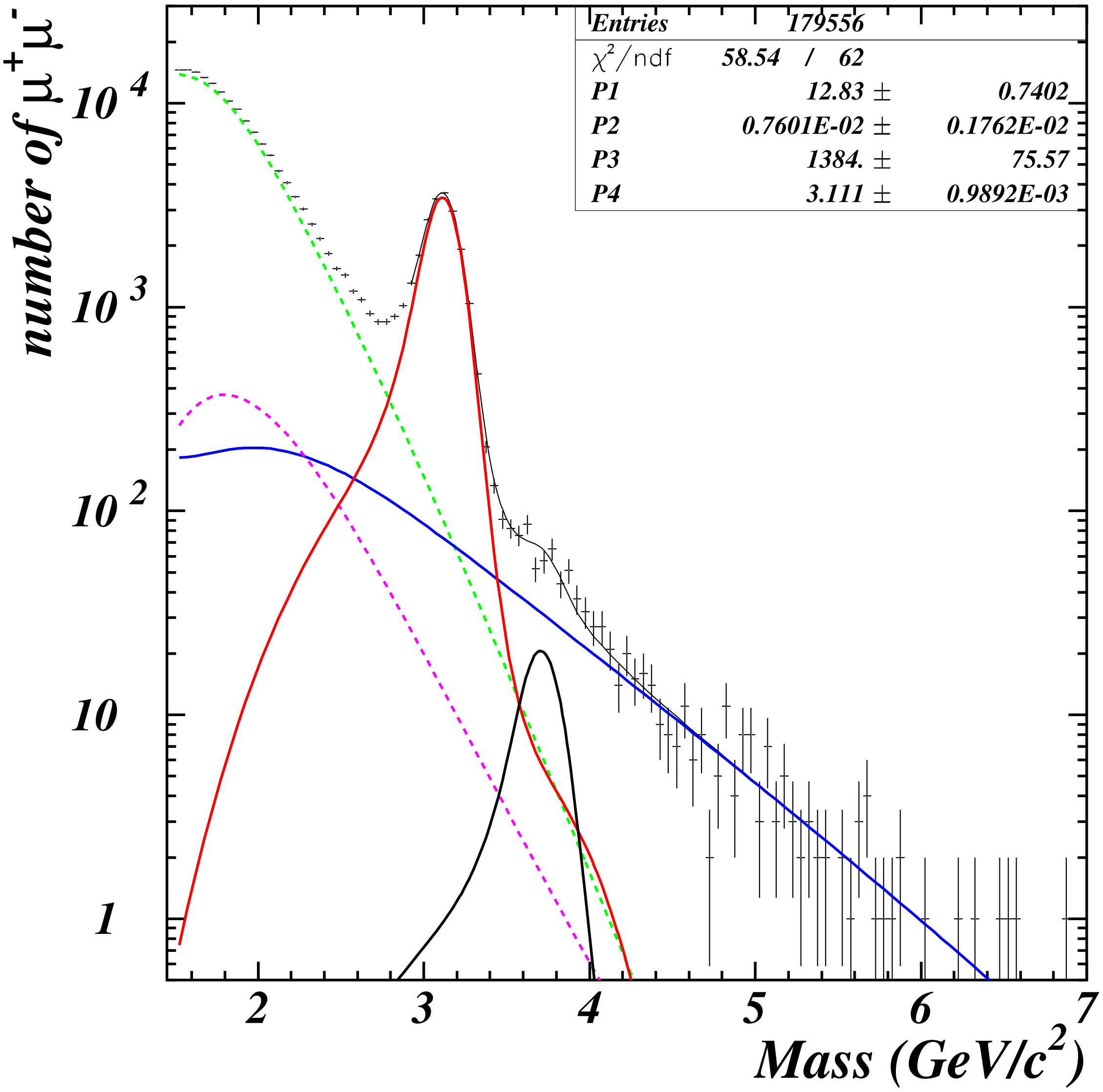
- More details ➪ talk by P. Cortese in Monday's parallel session

Normal absorption of J/ψ



- Normalization constrained by S-U NA38 measurement both for old and new absorption curve

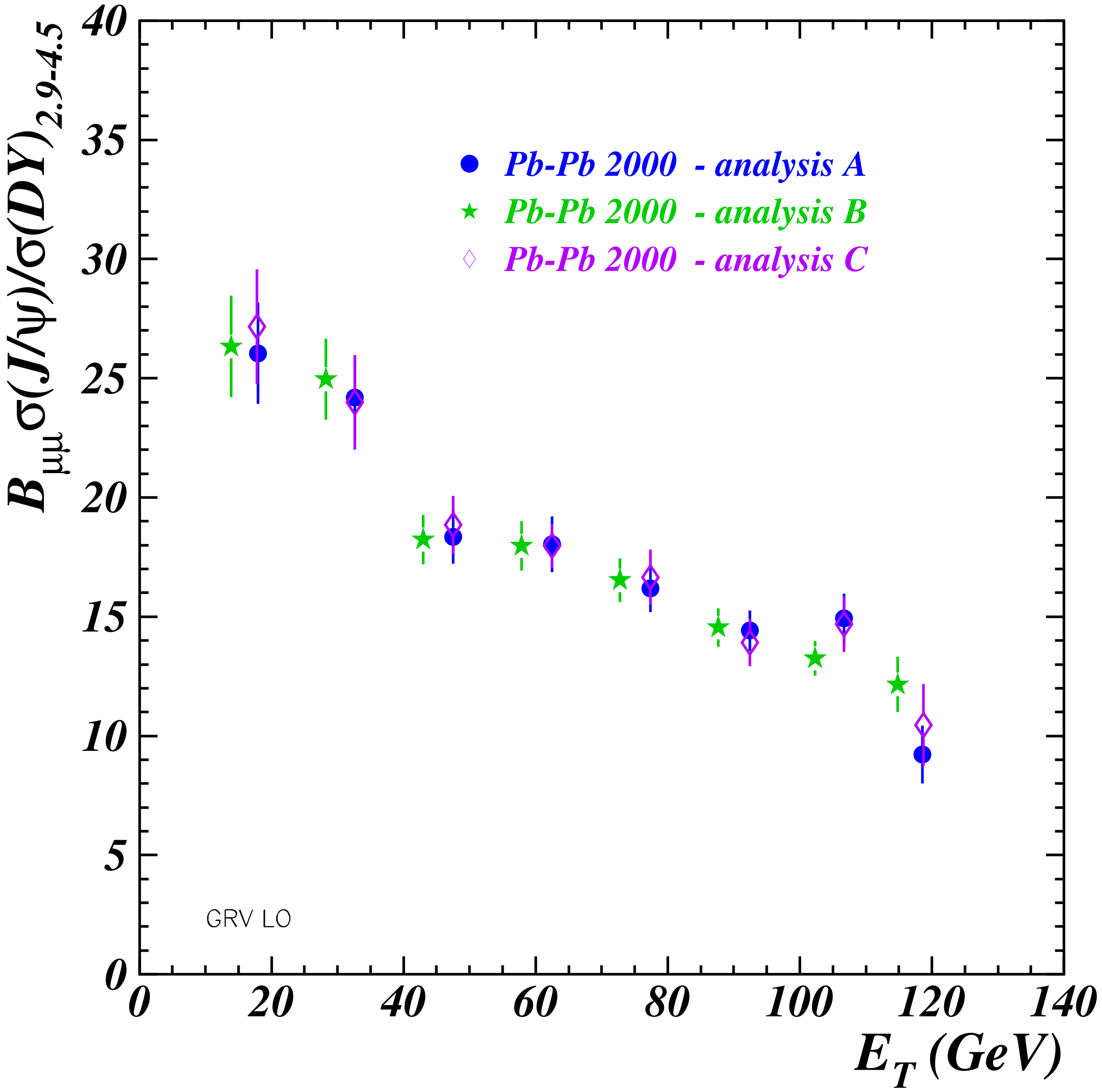
Fit to muon pair mass spectrum



final fit performed for $M > 2.9$ GeV/c^2

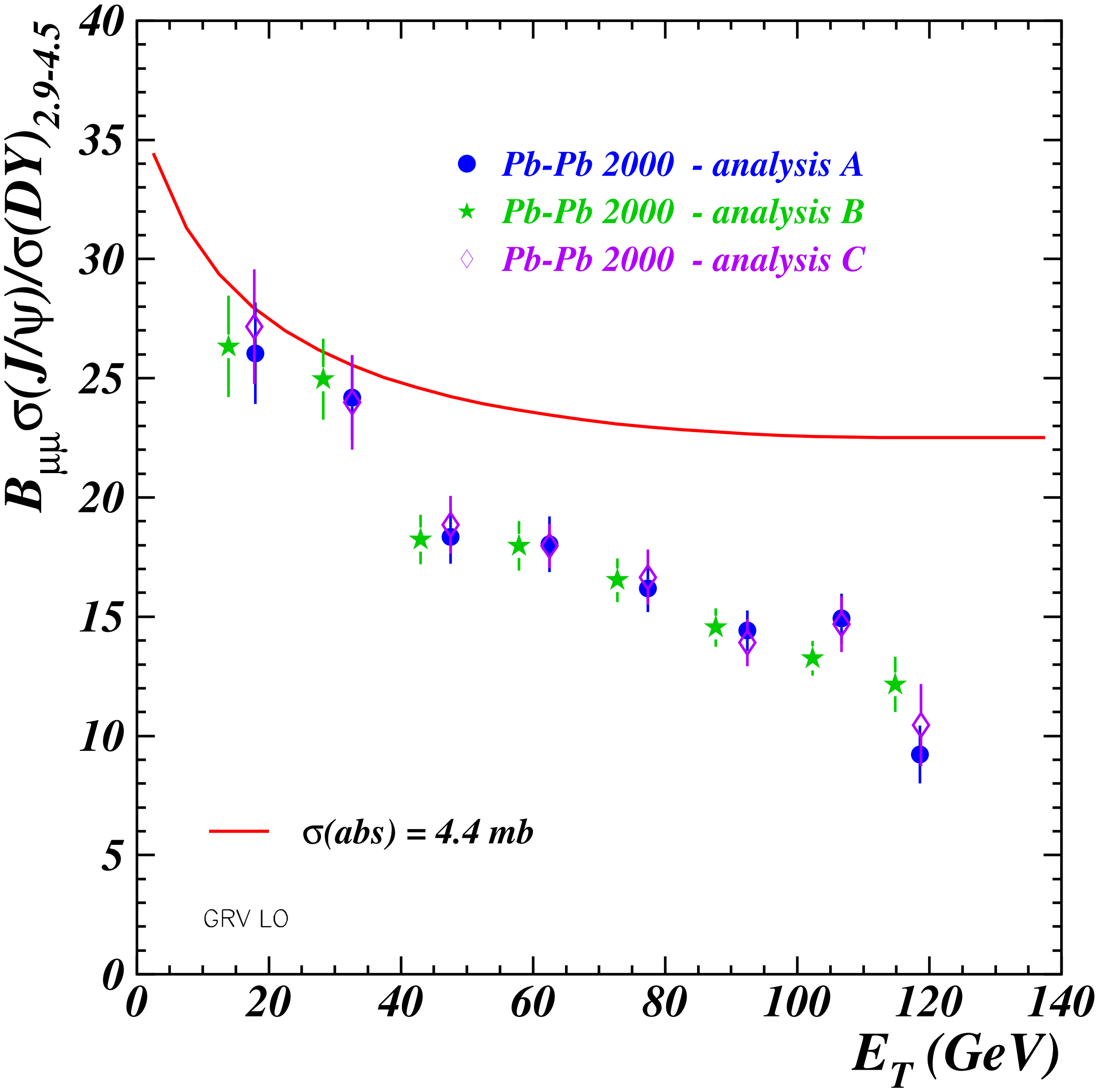
we have noted that results depend on the PDF parametrization used, as will be shown later, because of the way we fit the DY contribution

2000 results vs. E_T (I)



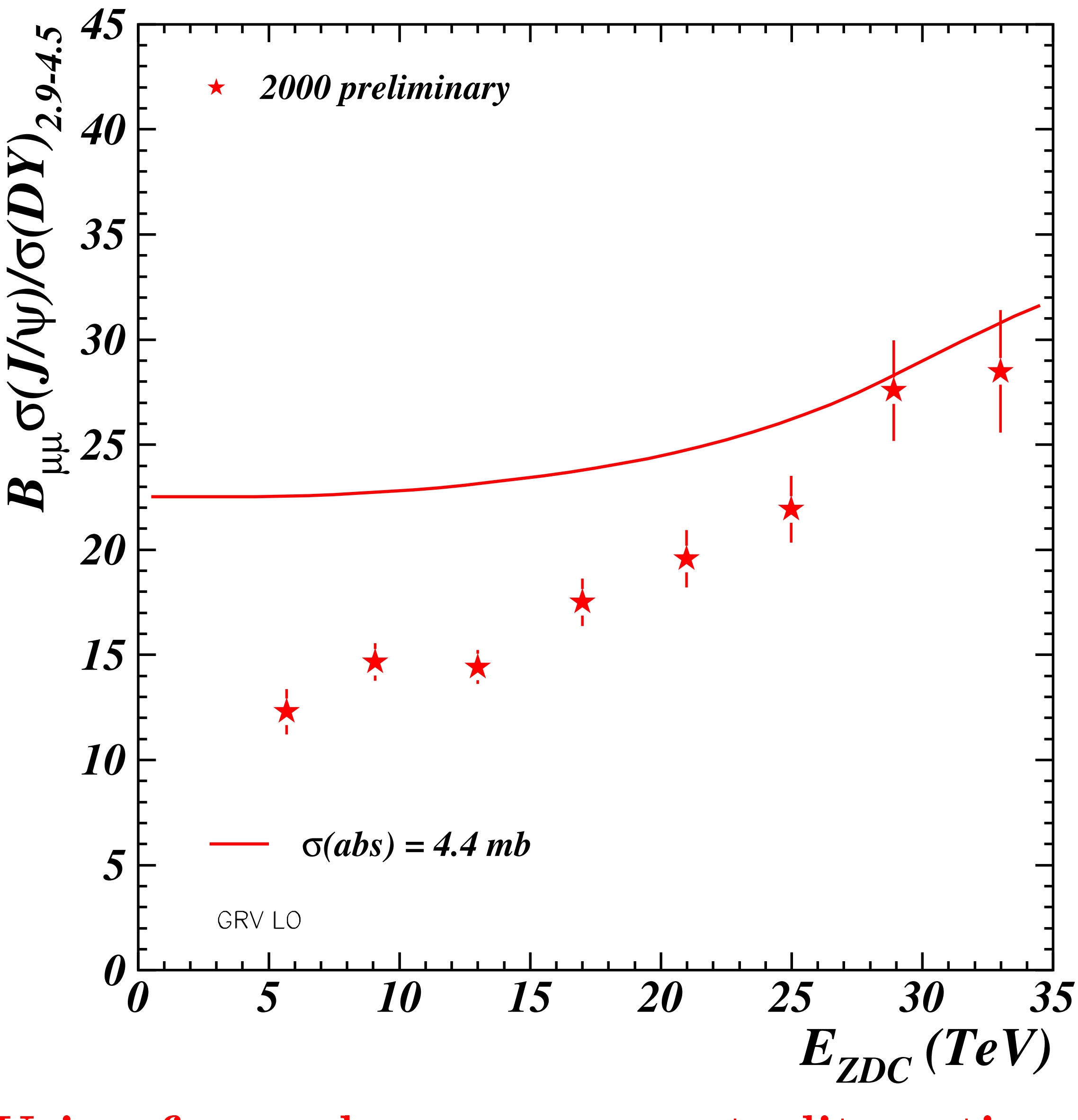
three independent analyses (selection criteria, analysis methods) in three different labs are consistent within few %

2000 results vs. E_T (II)



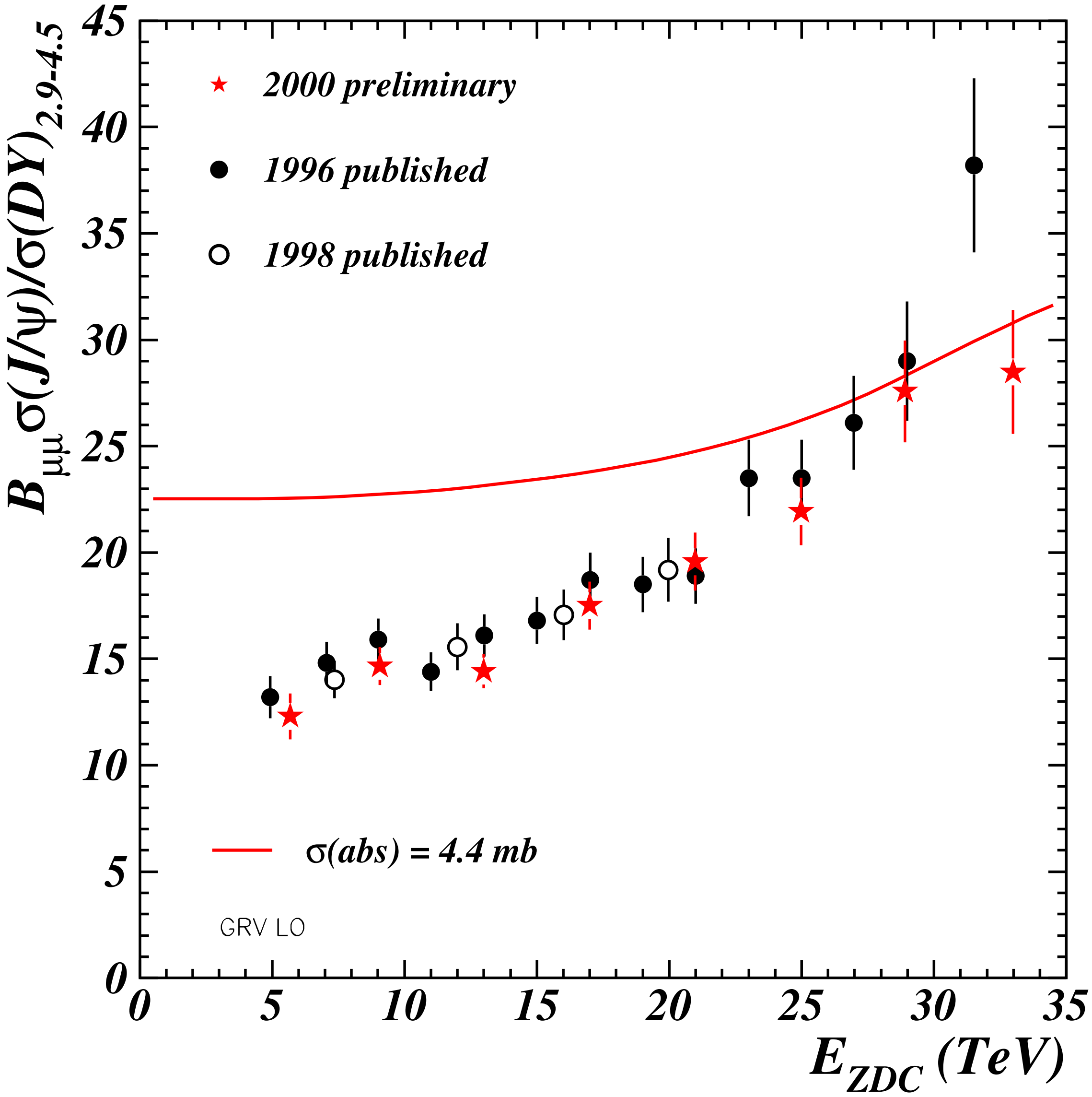
- J/ψ production in peripheral Pb-Pb collisions follows normal nuclear absorption pattern deduced from p-A and S-U collisions
- no saturation at high E_T

2000 results vs. E_{ZDC}



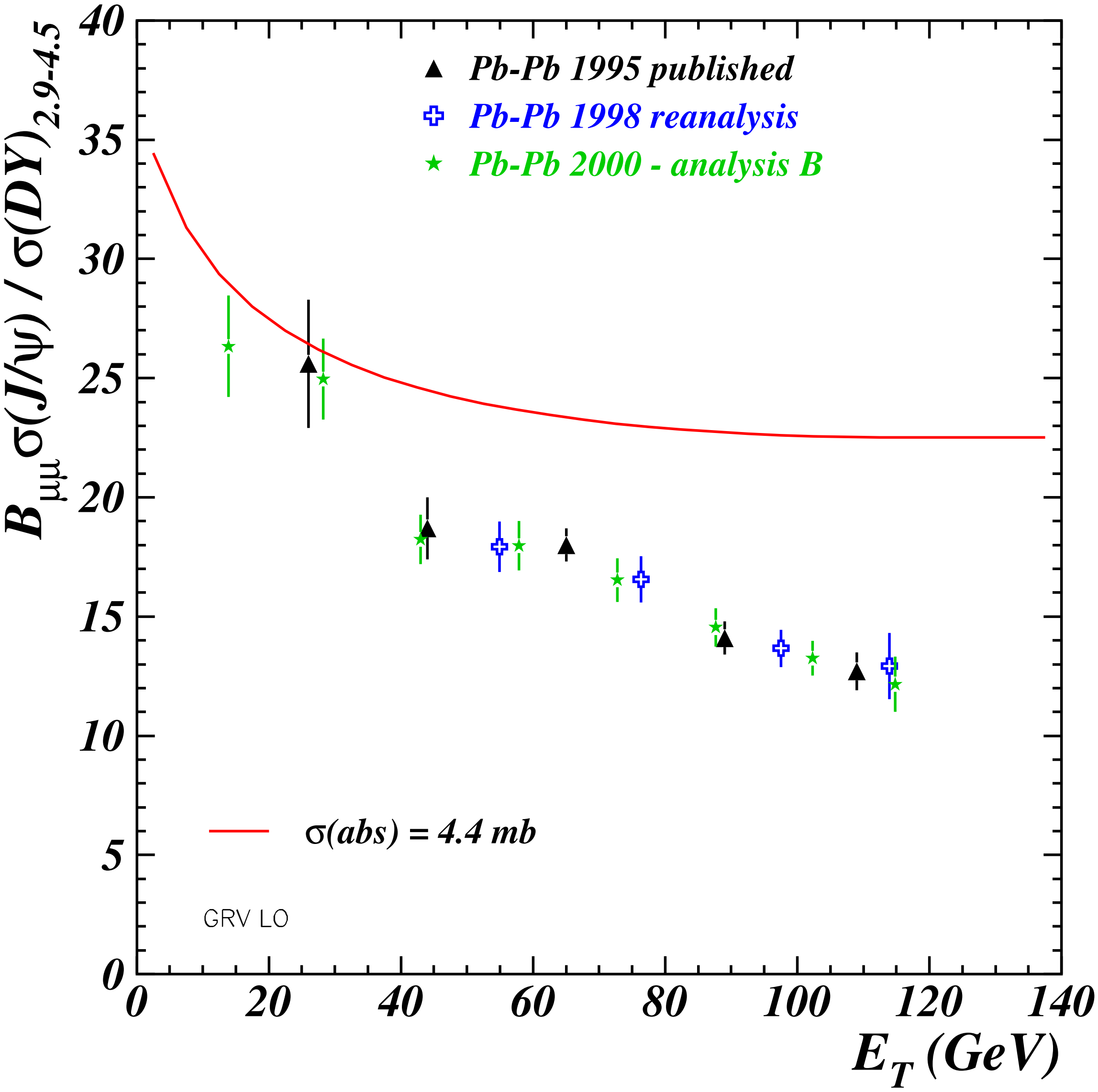
Using forward energy as centrality estimator, J/ψ production in peripheral Pb-Pb collisions again follows normal nuclear absorption as deduced from p-A and S-U collisions

2000 results vs. E_{ZDC} (cont.)



Except for most peripheral collisions (probably contaminated by Pb-air interactions in the past), good agreement with published analyses

2000 results vs. E_T (III)



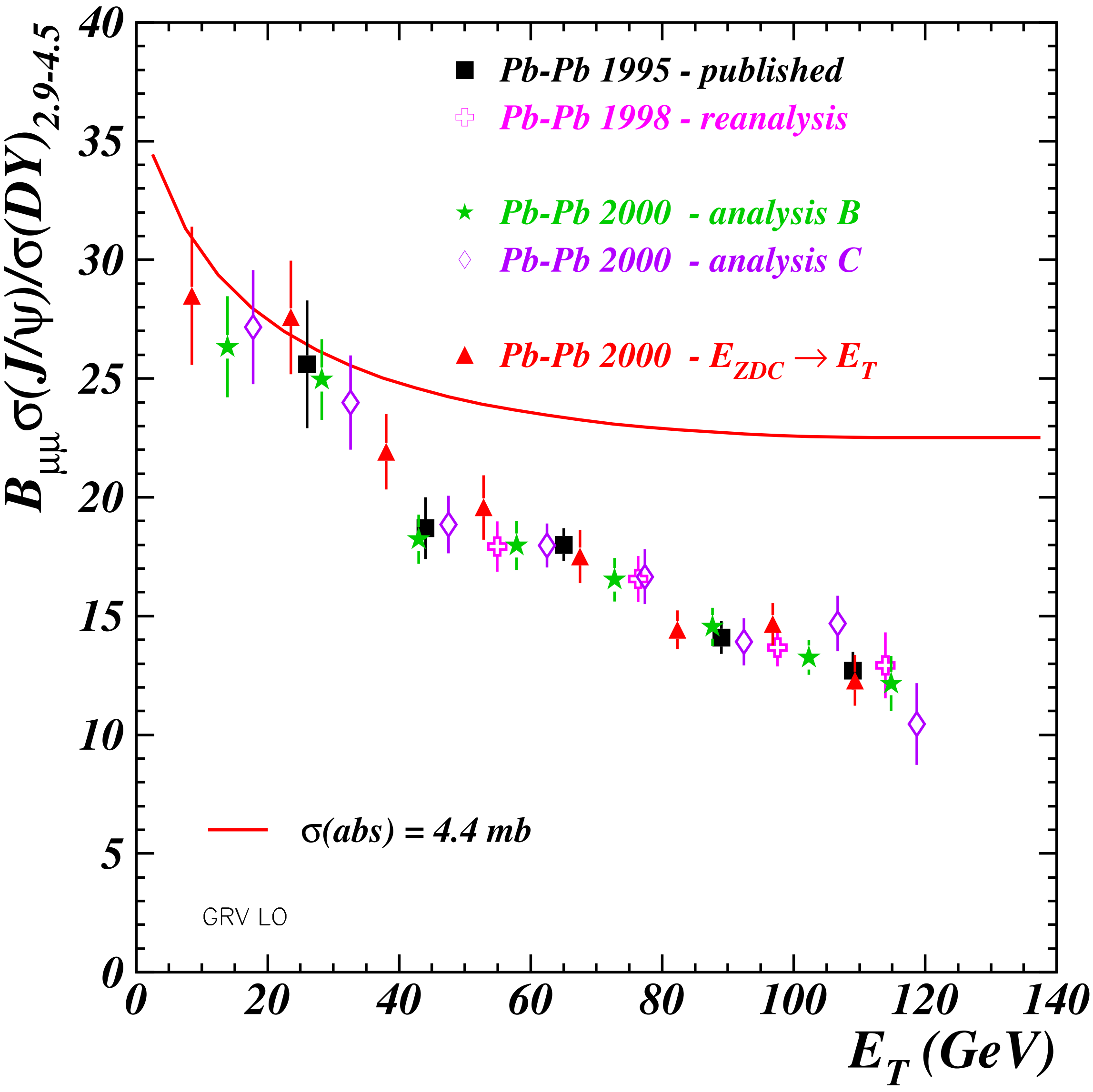
Different analyses of same data and also different sets of data allow us to establish three conclusions:

(i) peripheral interactions agree with normal absorption

(ii) there is a departure at $E_T \simeq 40$ GeV

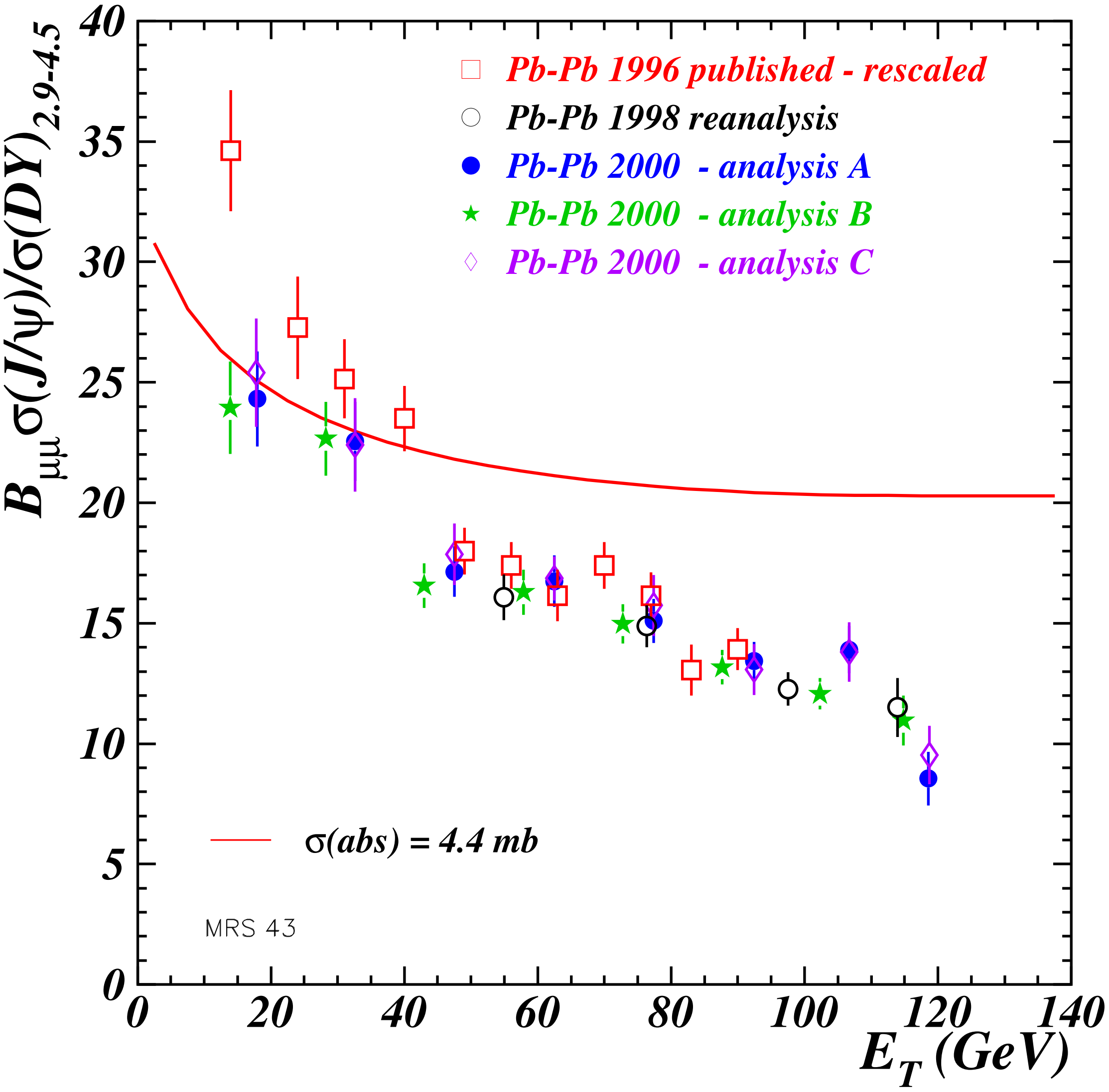
(iii) there is no saturation at high E_T

E_T and E_{ZDC} analyses



given the different resolutions vs. centrality of the two calorimeters, the E_{ZDC} analysis translated to E_T shows a fair agreement with E_T analyses

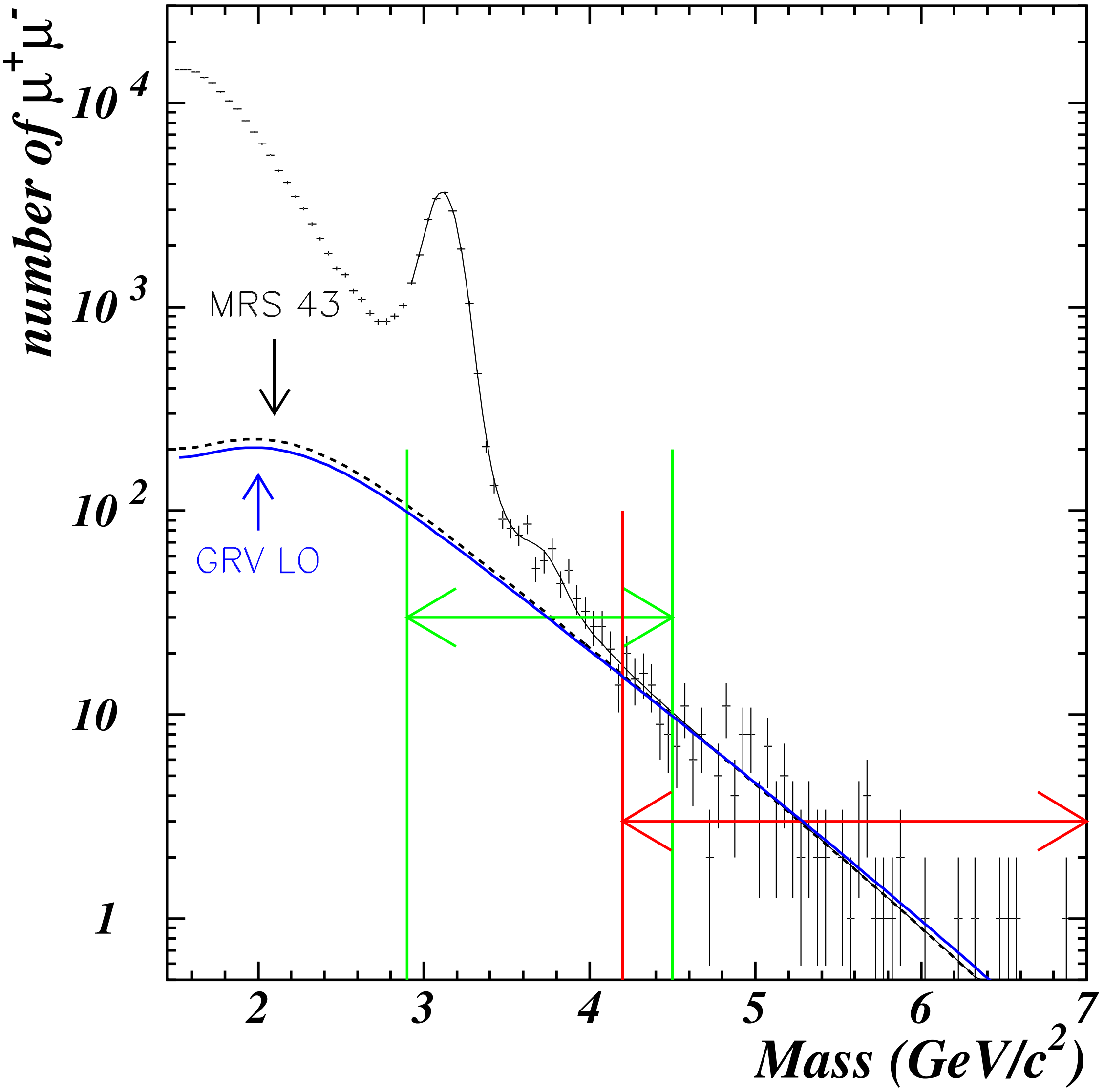
2000 results vs. E_T - MRS 43



- Same pattern vs. E_T as in the GRV LO analysis, but slightly different absolute value of $B_{\mu\mu}\sigma(J/\psi)/\sigma(DY)_{2.9-4.5}$

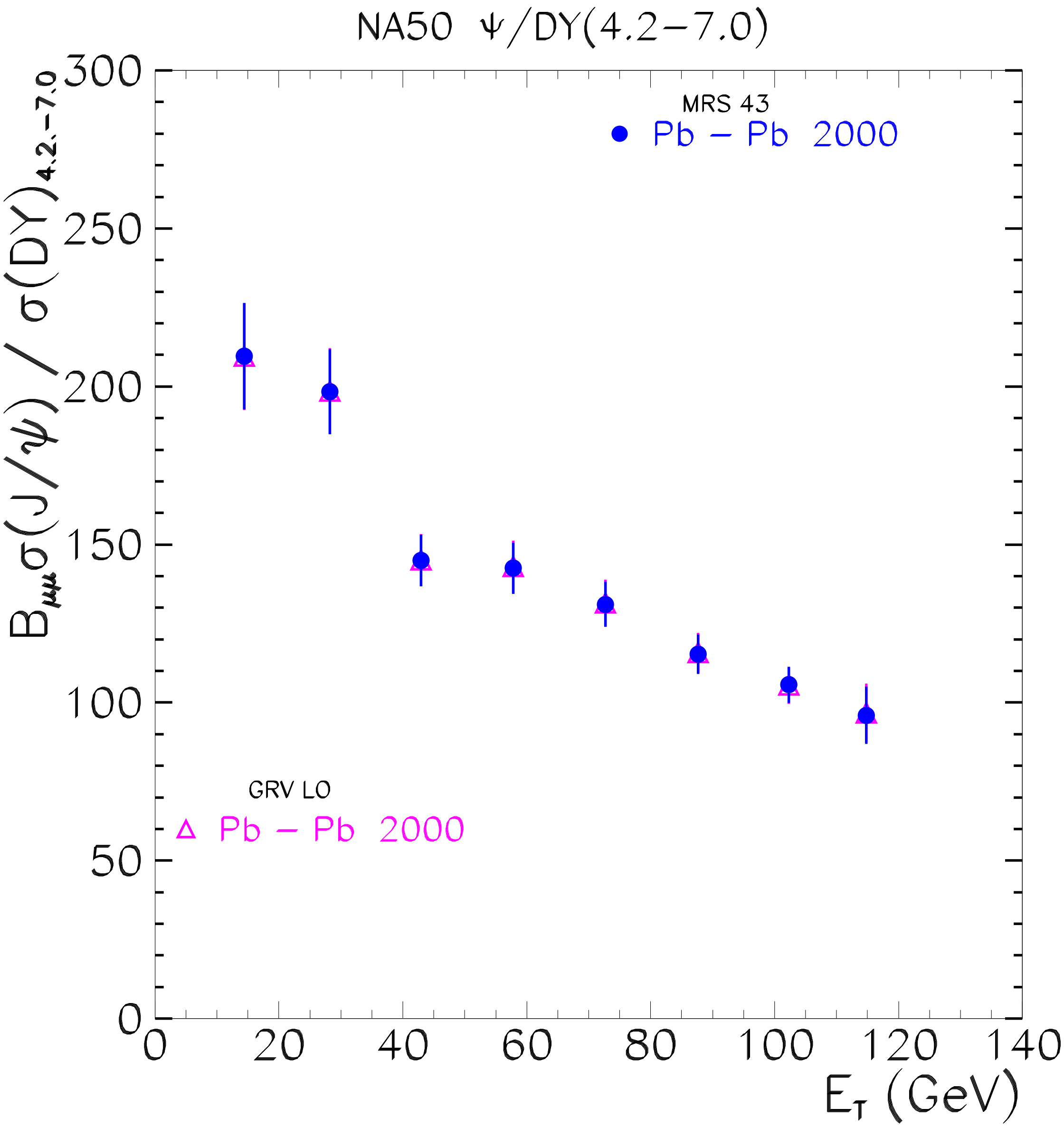
- when coherently compared, published MRS 43 analyses agree reasonably well with 2000 results

New reference: DY(4.2-7.0)



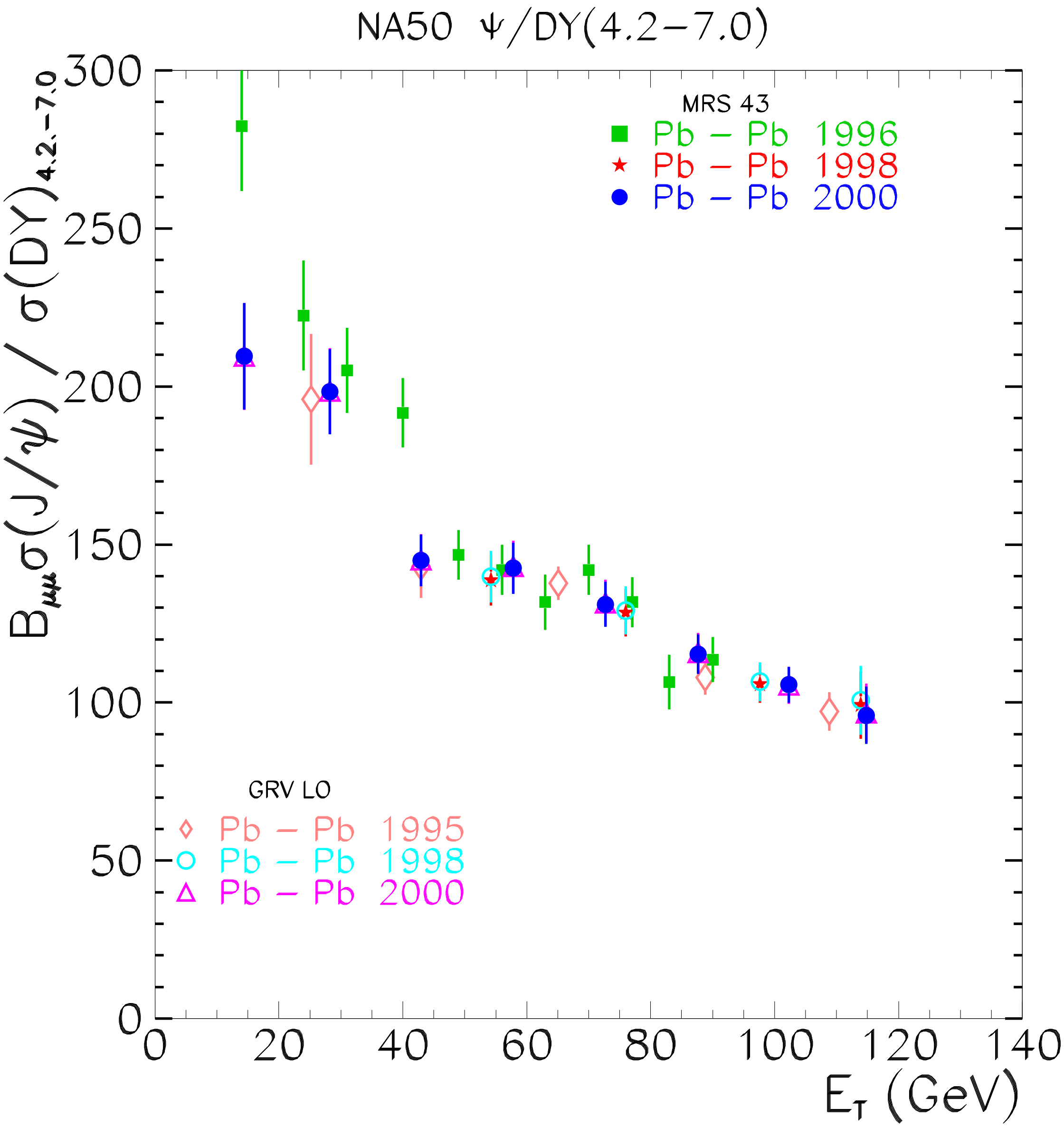
- $\sigma_{DY}(2.9 - 4.5)$ depends on extrapolation of dN_{DY}/dM from mass region where DY is directly measured
- different parton distributions lead to different results
- directly measured $\sigma_{DY}(4.2 - 7.0)$ ➪ unique result

2000 results: $(J/\psi)/DY(4.2-7.0)$



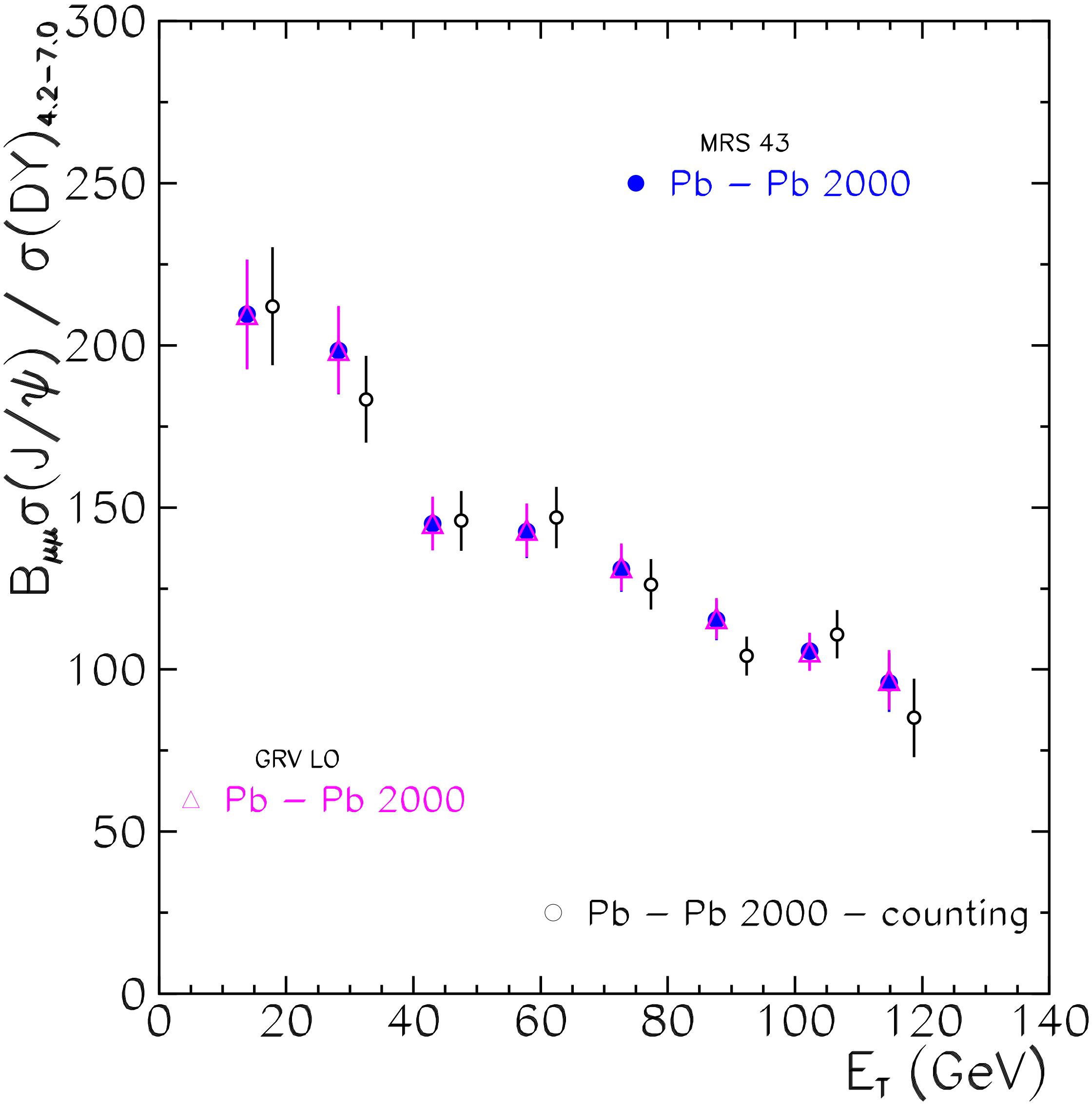
with this presentation our results do not depend any more on the chosen set of parton distribution functions

Pb-Pb results: $(J/\psi)/DY(4.2-7.0)$



comparison with previous years shows reasonable agreement (except for most peripheral point in 1996)

2000 results: $(J/\psi)/DY\,(4.2 - 7.0)$



a cross-check performed by counting J/ψ's and high mass DY pairs shows good consistency with the usual result obtained by fitting invariant mass distributions

Summary

PRELIMINARY **results from the most recent NA50 data:**

- **confirm the J/ψ suppression pattern: threshold effect followed by a steady decrease for the most central Pb-Pb collisions**

- **confirm the departure from an improved normal nuclear absorption as determined from p-A and S-U interactions**

- **indicate that the most peripheral Pb-Pb interactions for impact parameter $b > 8.5$ fm indeed follow the normal nuclear absorption pattern**