New results on J/ψ suppression from the NA50 Experiment

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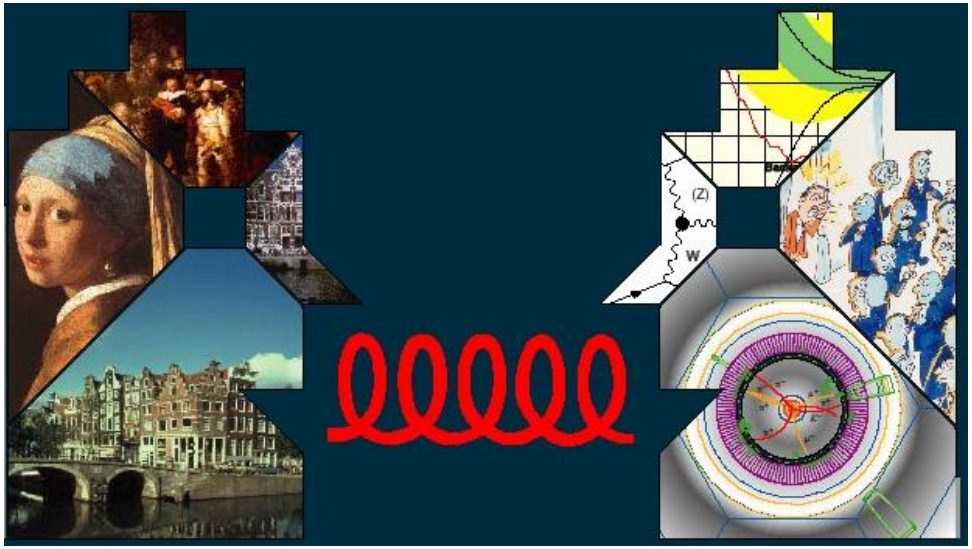

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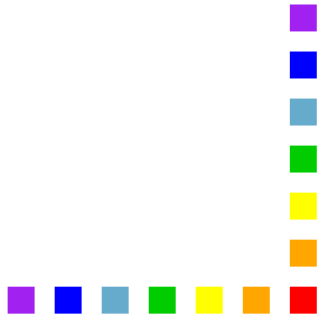
Outline

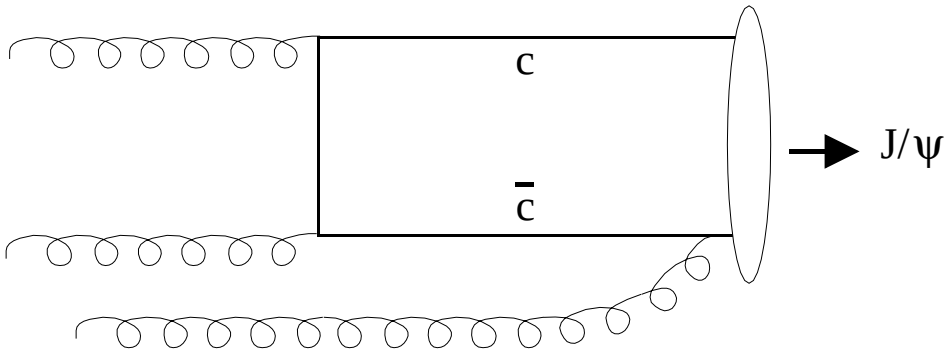
- The aim of the experiment: J/ψ probe for QGP
- The NA50 apparatus
- Kinematical domain and event selection
- The reference: the Drell-Yan process for standard J/ψ analysis
- Measurement of anomalous J/ψ suppression
- Summary and conclusions

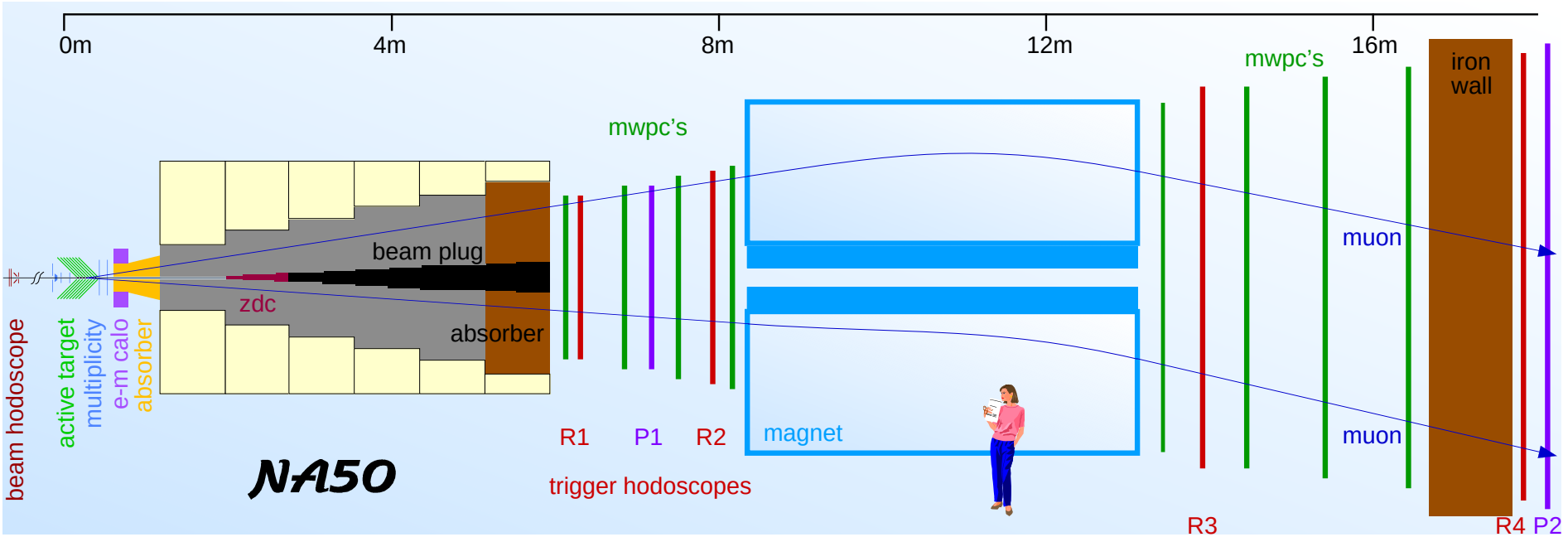


The aim of the experiment: J/ψ as probe of QGP

Prediction by Matsui and Satz in 1986:

In the dense medium produced from a heavy ion collision, c and $\bar{c}$ quarks created cannot "see" each other, due to the color screening of other quarks and gluons. The system expands and cools. When freeze-out occurs the c and $\bar{c}$ quarks are already too far apart to hadronize as a charmonium state (J/ψ, ψ',...) $\rightarrow$ J/ψ suppression is a signature for the early dense system.





- Trigger given by dimuon detection in:

  $0. \leq Y^{CM} < 1.$ and $|\cos\theta_{CS}| < 0.5$

- Collisions centrality measured by:

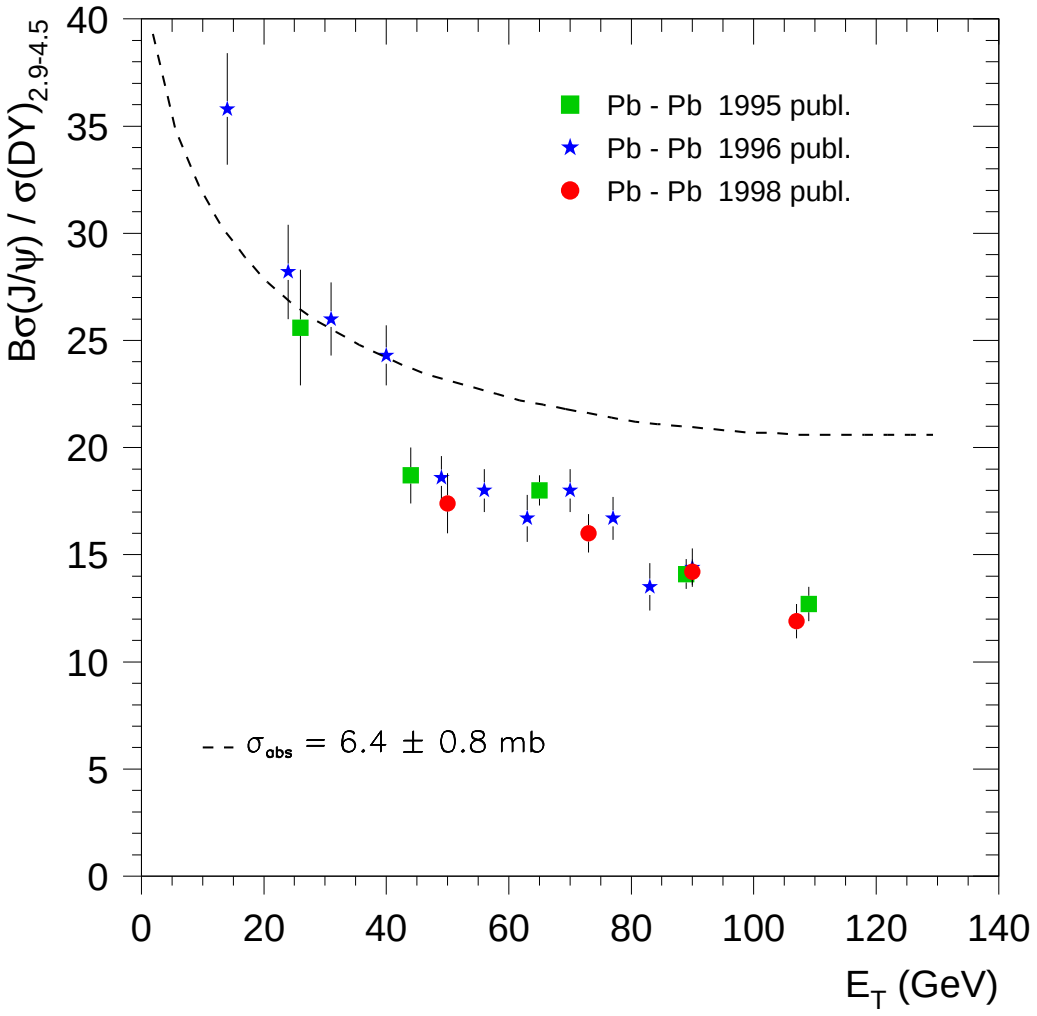
  ↪ electromagnetic calorimeter ($1.1 \leq \eta^{lab} < 2.3$)

  ↪ zero degree calorimeter ($\eta^{lab} > 6.3$)

  ↪ multiplicity detector ($1.9 \leq \eta^{lab} < 4.2$)

NA50 standard published analysis: J/ψ/DY

Observation of anomalous J/ψ suppression



- A threshold effect followed by steady decrease for central Pb-Pb collisions.
- Clear departure from normal nuclear absorption curve. But:

  ↪ Peripheral Pb-Pb interactions have some contamination from Pb-Air background.

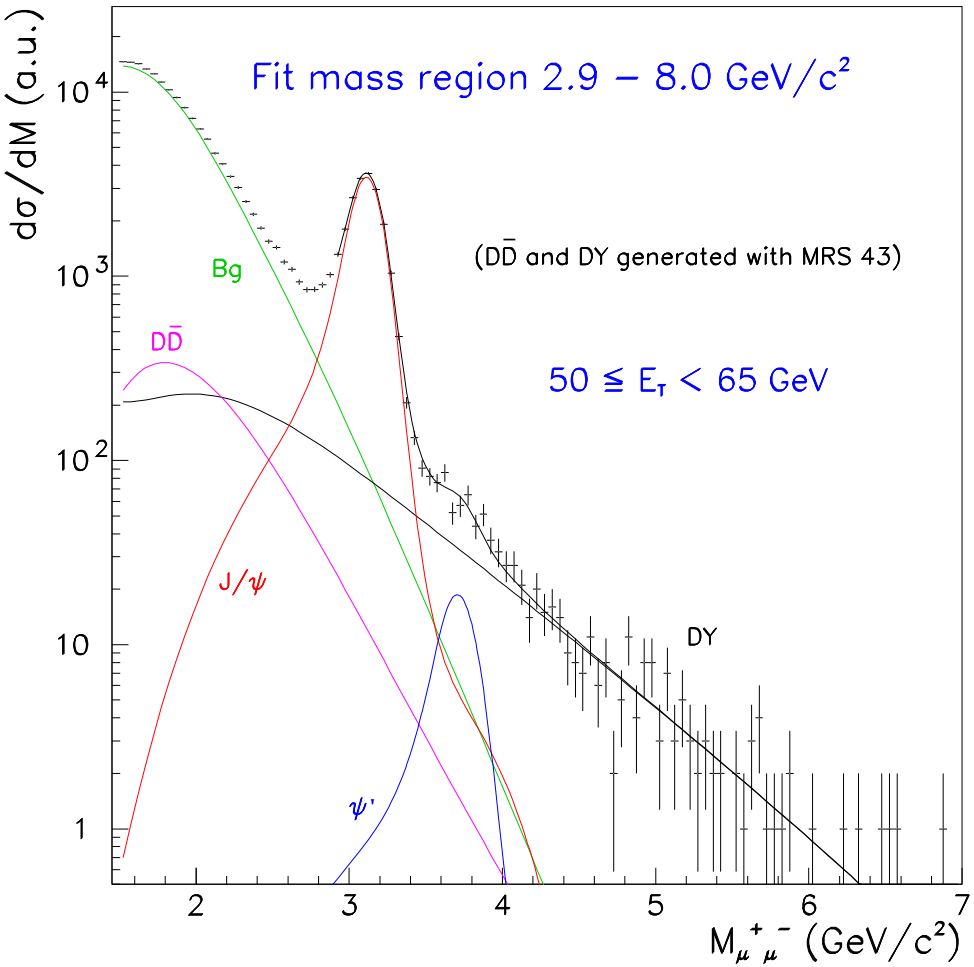
NA50 lead data

Data period	total target thickness	subtargets	target region	beam intensity (ions/burst)	number J/ψ
1995	17% λ_I	7	air	3×10^7	50000
1996	30% λ_I	7	air	5×10^7	190000
1998	7% λ_I	1	air	5.5×10^7	40000
2000	9.5% λ_I	1	vacuum	7×10^7	120000

- In 2000 the target region was placed under vacuum up to the preabsorber.
- New high statistics p-A data allows for better precision in measurement of normal nuclear absorption curve used as baseline – taken both from p-A and S-U collisions (NA50, NA51 and NA38 – all using same spectrometer).

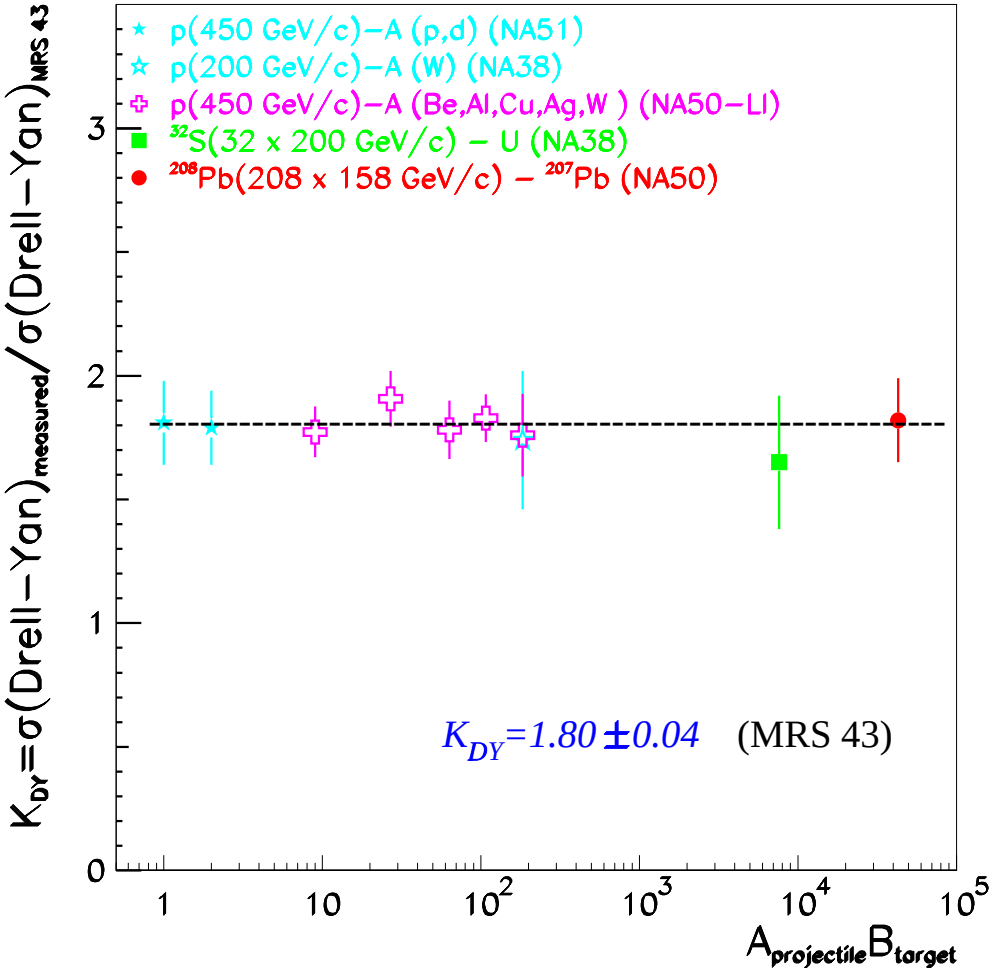
Mass fit method

$$\frac{dN}{dM} = A_{J/\psi}\frac{dN_{J/\psi}}{dM} + A_{\psi'}\frac{dN_{\psi'}}{dM} + A_{DY}\frac{dN_{DY}}{dM} + \frac{dN_{D\bar{D}}}{dM} + \frac{dN_{Bg}}{dM}$$



$D\bar{D}$ decays and Drell-Yan process are generated using both GRV LO or MRS 43 PDF.

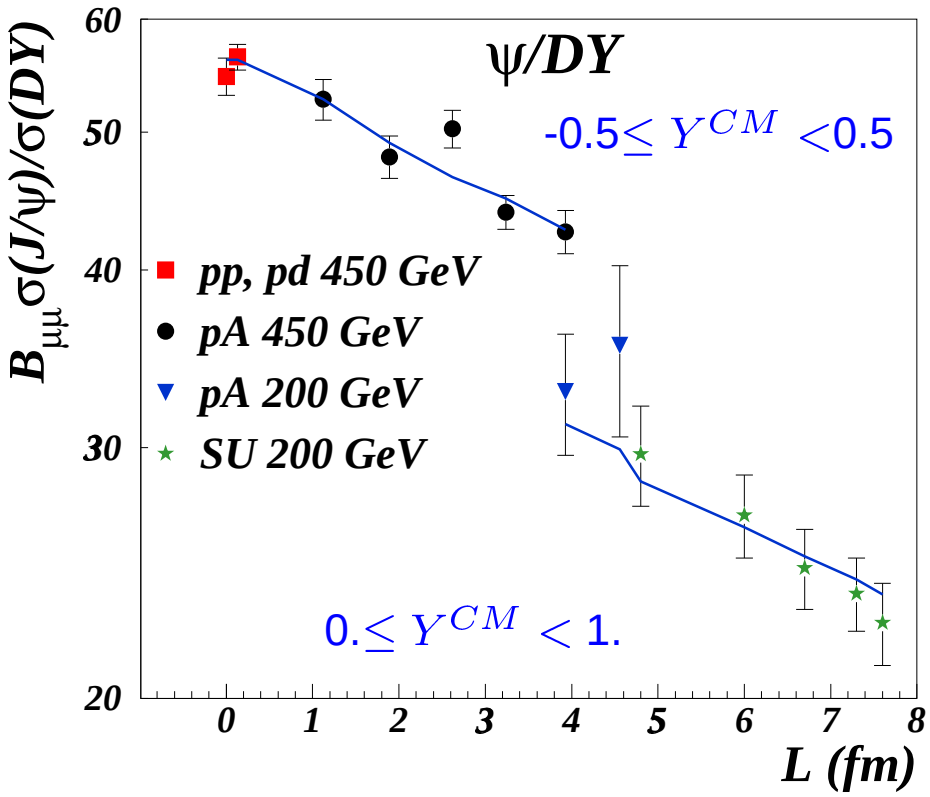
Reference for the J/ψ studies: Drell-Yan



Drell-Yan process is used as reference to study the production of J/ψ, since this is a well-known hard process, with cross-section $\sigma_{DY} \propto (AB)^{\alpha}$ and $\alpha = 1$.

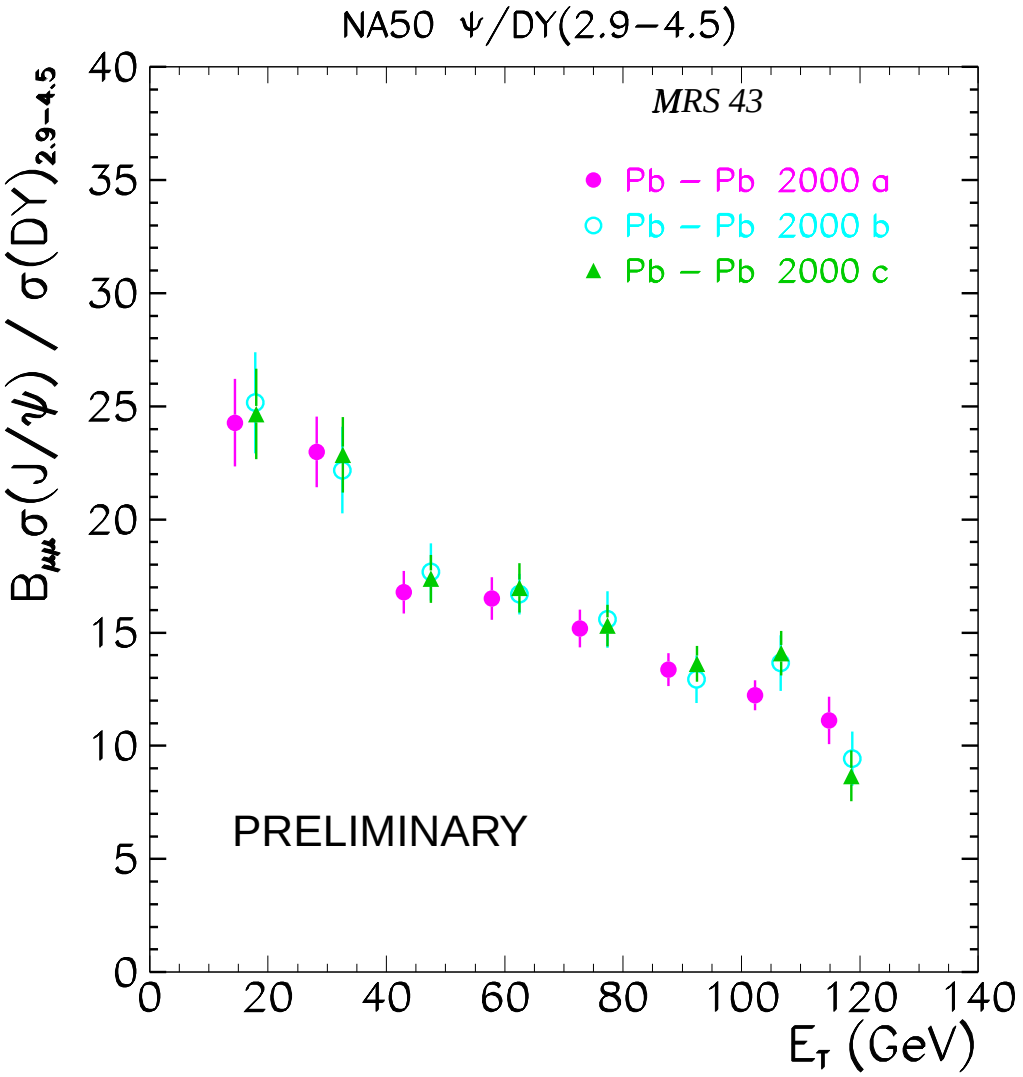
J/ψ normal nuclear absorption

Normal nuclear absorption of charmonia states in dense media is measured in p-A and S-U collisions (present NA50, and previous NA51 and NA38 experiments).



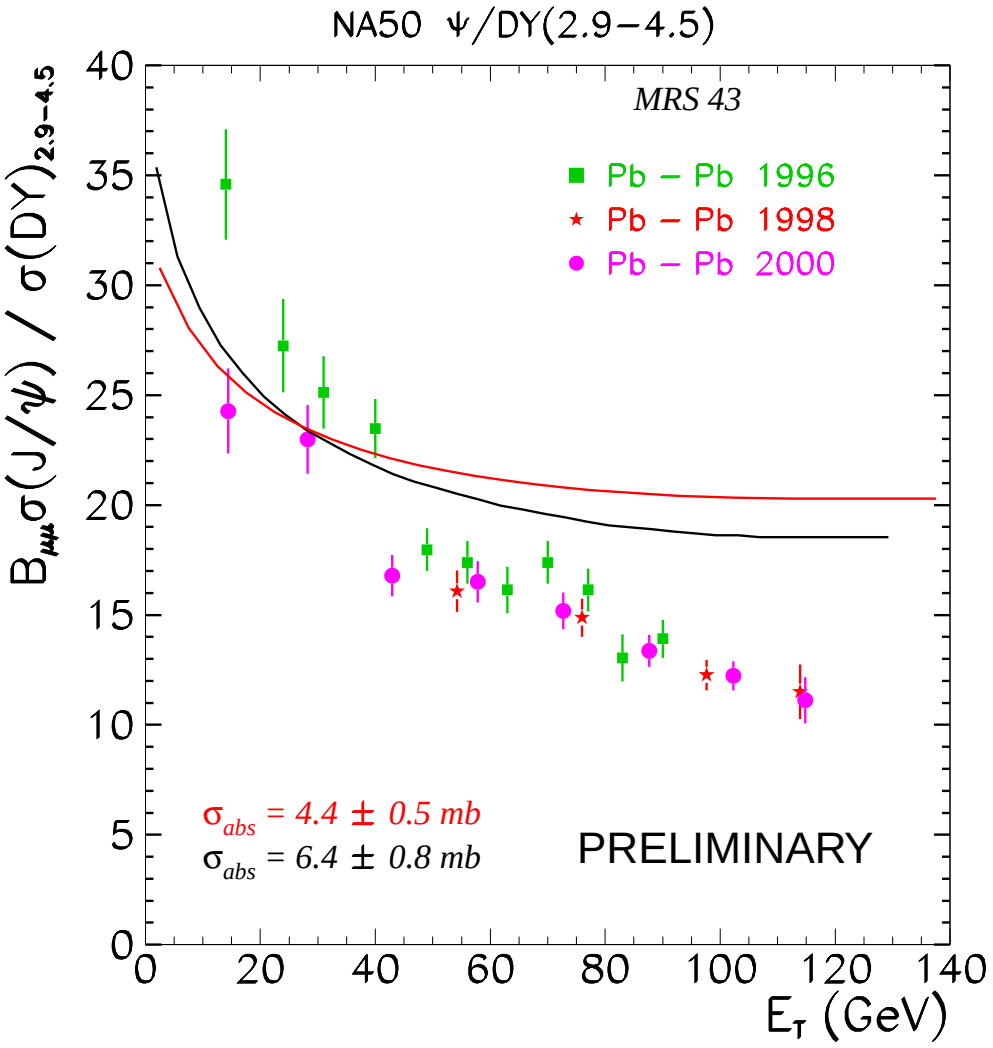
Using a Glauber model fit, the absorption cross-section for charmonia states obtained is $\sigma_{abs} = 4.4 \pm 0.5$ mb.

Pb-Pb 2000 results



- 3 different analyses (different data selections and fit methods) are consistent within a few %.

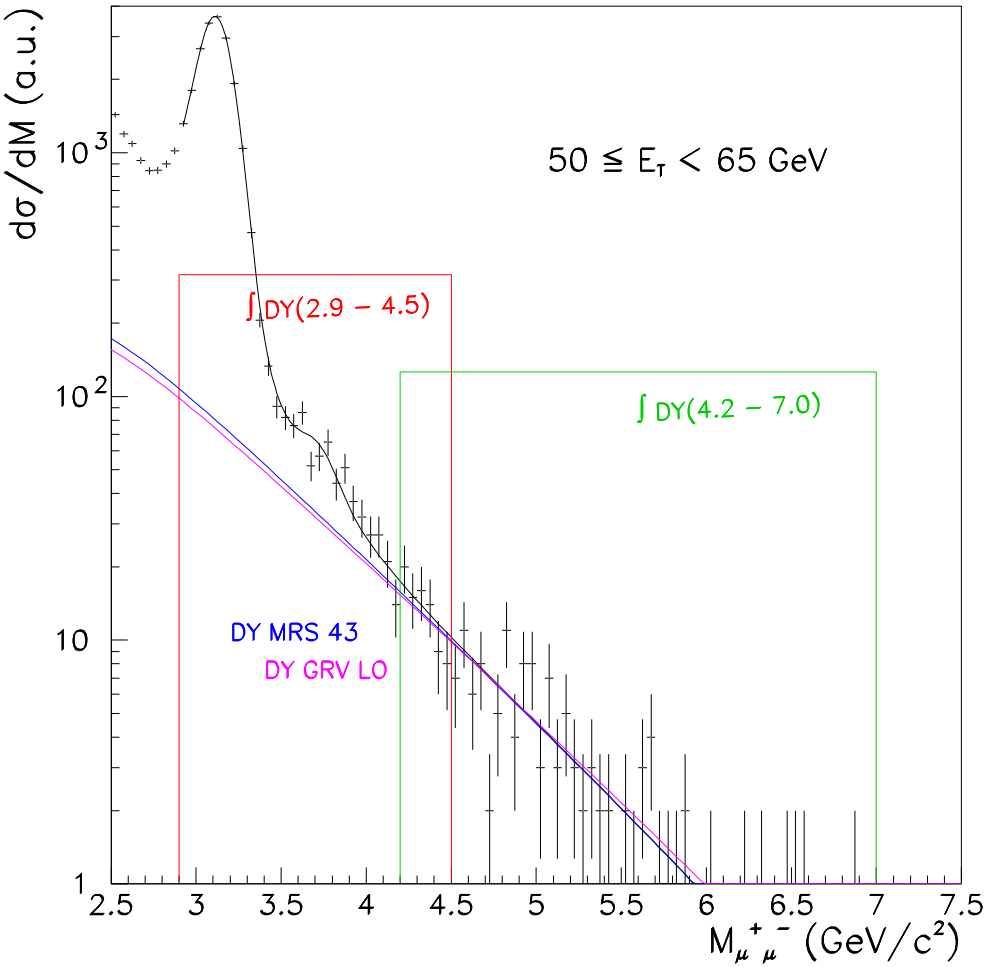
Comparison of several Pb-Pb data takings



- 1998 published data re-analised with 2000 analysis criteria.
- 1996 published data with 3.5% correction to put it on same analysis conditions.
- New normal nuclear absorption curve as measured by NA50+NA51+NA38
- E_T scales of 1998 and 2000 data renormalised to the 1996 one.

All data sets show good agreement within a few %.

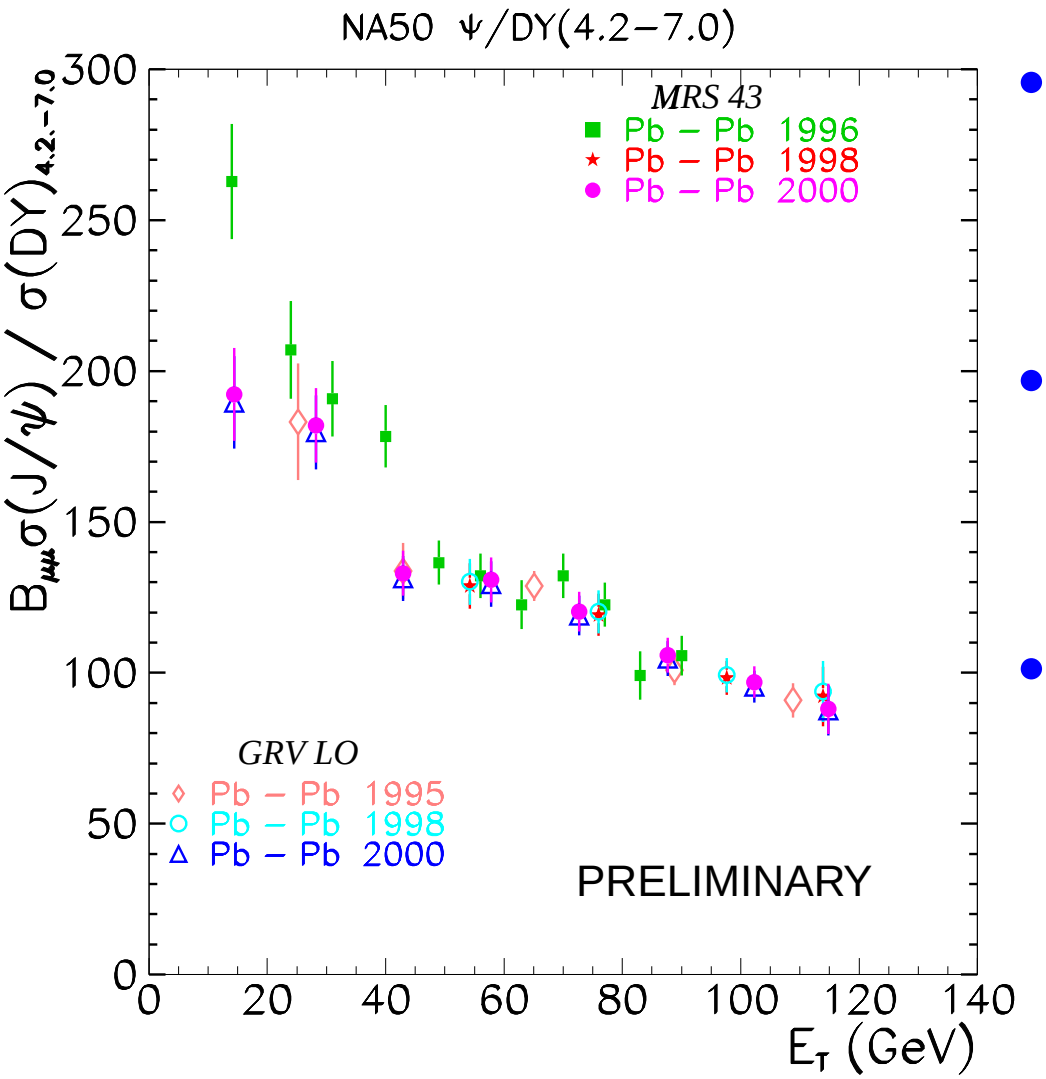
Drell-Yan reference in a new mass region



- The backwards extrapolation of Drell-Yan process, calculated with MRS 43 or GRV LO gives different results.

↪ While this contribution in the mass region 2.9 – 4.5 GeV/c^2 differs by **10%** between the two PDF, for the mass region 4.2 - 7.0 GeV/c^2 this difference is negligible.

NA50 Pb-Pb data: J/ψ/DY$\big|_{4.2-7}$



- J/ψ/DY$\big|_{4.2-7.0}$ results are independent of the PDF used for Drell-Yan.
- Clear stepwise pattern of anomalous J/ψ suppression is seen in all Pb-Pb data.
- Very good compatibility between the different data takings, but 1996 peripheral data have contamination from Pb-air interactions.

Summary and Conclusions

Results from the NA50 Pb-Pb 2000 data with target in vacuum:

- confirm the anomalous J/ψ suppression;
- confirm a departure from the normal nuclear absorption curve;
- indicate that peripheral interactions do follow the normal nuclear absorption behaviour.