Multi-differential study of J/ψ yield at forward rapidity in Pb-Pb collisions at $\sqrt{s_{\mathrm{NN}}} = 5.02$ TeV with ALICE

Hushnud[1] and Jhuma Ghosh[1] for ALICE Collaboration

[1]Saha Institute of Nuclear Physics, Kolkata, India

hushnud.hushnud@cern.ch

Introduction

- At high temperature, Lattice Quantum Chromodynamics predicts the existence of dense and hot nuclear matter which behaves as a deconfined medium of quarks and gluons. Inside such medium, quarkonium yields are suppressed due to the color screening effect. However, at LHC energies, the magnitude of the suppression is smaller in comparison to SPS and RHIC, indicating the important role played by the (re)generation of charmonium. This effect is more prominent at lower dimuon transverse momentum ($p_{\mathrm{T}} <$ 4 GeV/c) and in central Pb-Pb collisions.
- The commonly used temperature profile in rapidity direction is a broad plateau with Gaussian limited fragmentation at larger rapidity ($y \sim 10$). This is the case for elliptic flow calculations [1] as well as for the model by Strickland [2].

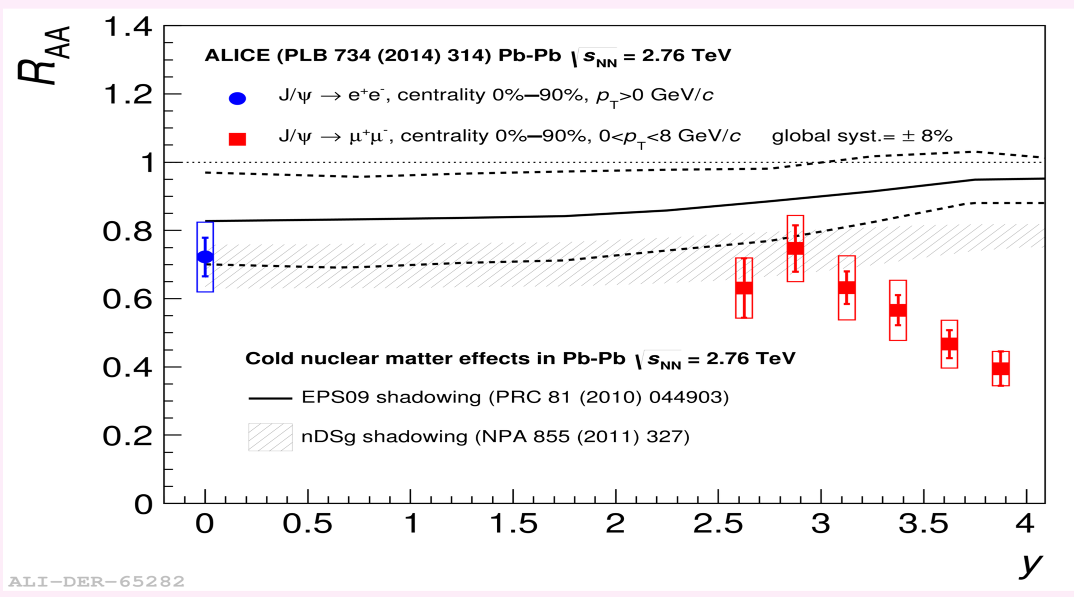

Figure 1 : R_{AA} as a function of rapidity in Pb-Pb collisions at $\sqrt{s_{\mathrm{NN}}} = 2.76$ TeV [3].

- Models of Cold Nuclear Matter effects predict R_{AA} slope as nearly flat as a function of y with increasing trend. The two shadowing models show a similar trend.
- However, an opposite trend of R_{AA} vs y has been observed for data in the $2.5 < y < 4.0$.
- Thus the aim of this analysis is to study the yield differentially in p_{T} and rapidity to provide further details on J/ψ production in Pb-Pb.

Experimental setup

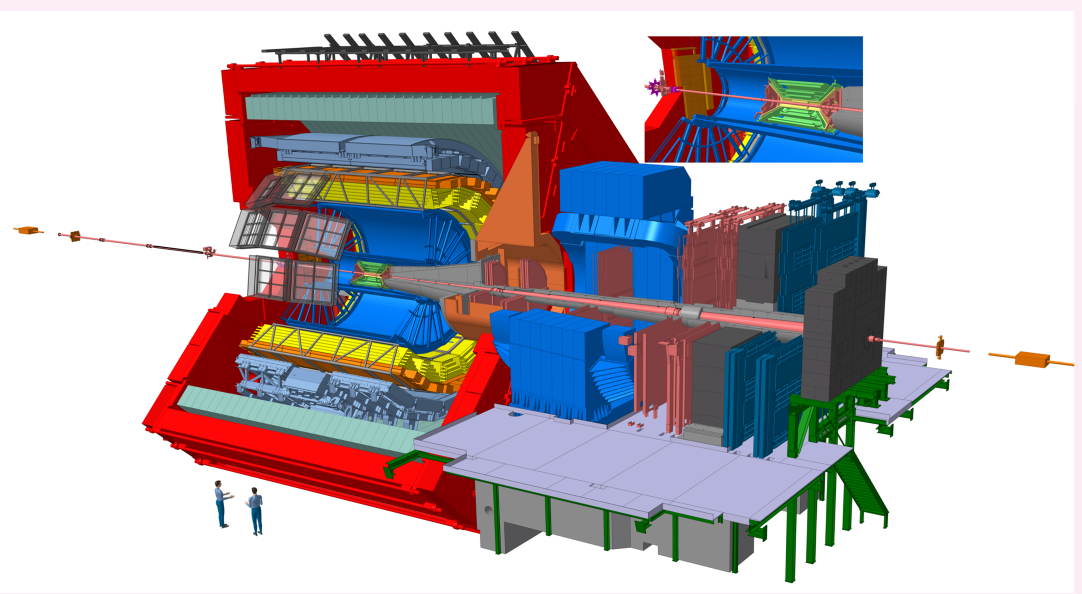

Figure 2 : The ALICE detector set-up.

- **Colliding system: Pb-Pb**
- **Colliding energy: $\sqrt{s_{\mathrm{NN}}} = 5.02$ TeV**
- **Luminosity:** $0.22\ \mathrm{nb}^{-1}$
- In the muon spectrometer quarkonia are reconstructed in the forward rapidity range $2.5 < y < 4$.

References

[1] M. Strickland *AIP Conf. Proc.* 1520, 179 (2013).

[2] S. Jeon et al. *Phys. Rev. C* 69, 044904 (2004).

[3] ALICE Collaboration, *Phys. Lett.* B734 314 (2014).

Analysis procedure

1. The number of J/ψ is obtained from fits to the opposite-sign dimuon invariant mass distributions. Fits are performed using a variety of signal functions (Crystal Ball and NA60) + background functions (Extended-Variable Width Gaussian function , ratio of second to third order polynomial and double-expontial for event-mixing), in the multi-differential bins of y, p_{T} and centrality. The bins considered for this analysis are:

∗3 bins in centrality (0-90%)

∗4 bins in $0 < p_{\mathrm{T}} < 12$ GeV/c

∗6 bins in $2.5 < y < 4.0$

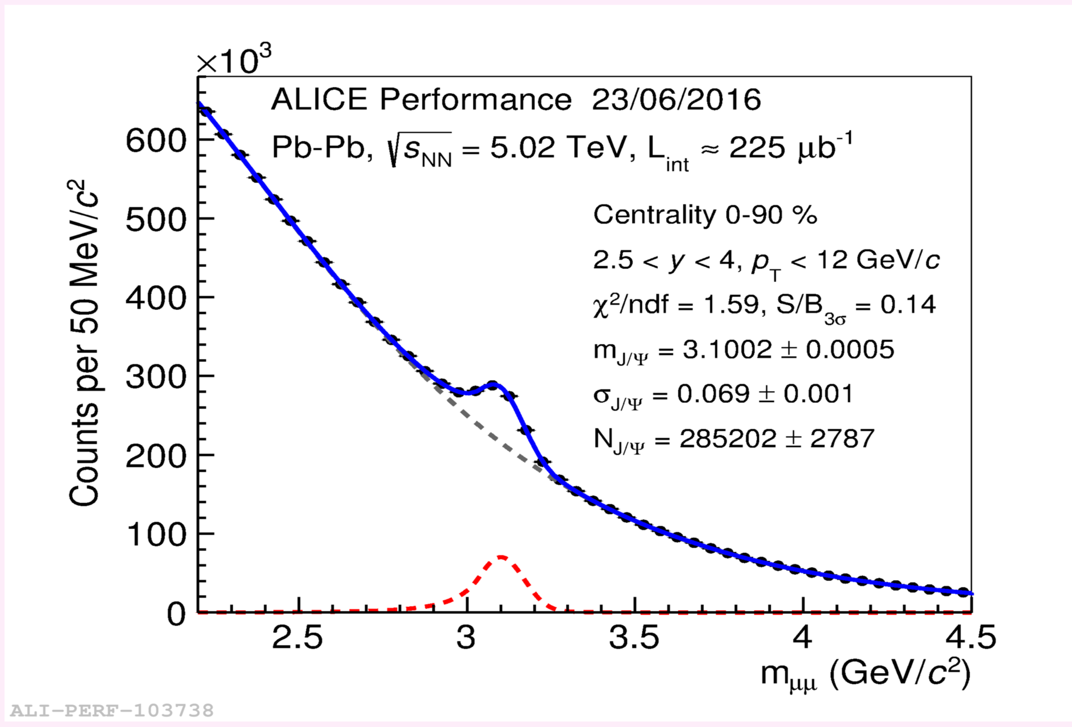

Figure 3 : An example of signal extraction.

2. The width of the J/ψ signal has been fixed and a systematic uncertainty of 15 % is assigned to take into account a possible bias.
3. $A \times \epsilon$ corrections are evaluated using embedded MC simulations and applying the following three weights:

- Number of dimuon triggered events for each run
- Number of measured J/ψ in each centrality bin
- p_{T} and y distribution functions of J/ψ in each centrality bin.

4. Extraction of $A \times \epsilon$ corrected number of J/ψ, known as yield, as a function of y in various p_{T} and centrality bins.
5. The extraction of rapidity slope parameters by fitting the corrected yields as a function of rapidity in each centrality and p_{T} bin.

Yield vs y in p_{T} and centality

The J/ψ yield is plotted as a function p_{T} in the double-differential bins of centrality and p_{T} bins.

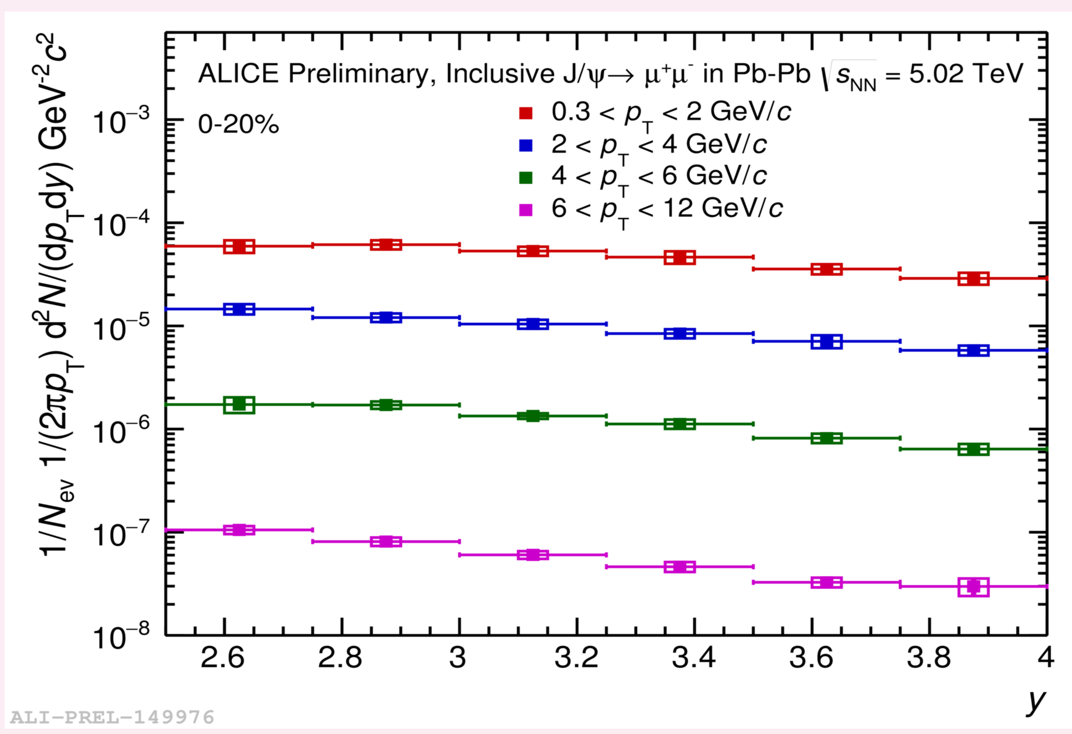

Figure 4 : J/ψ yield as a function of y in 0-20% centrality bin and p_{T}.

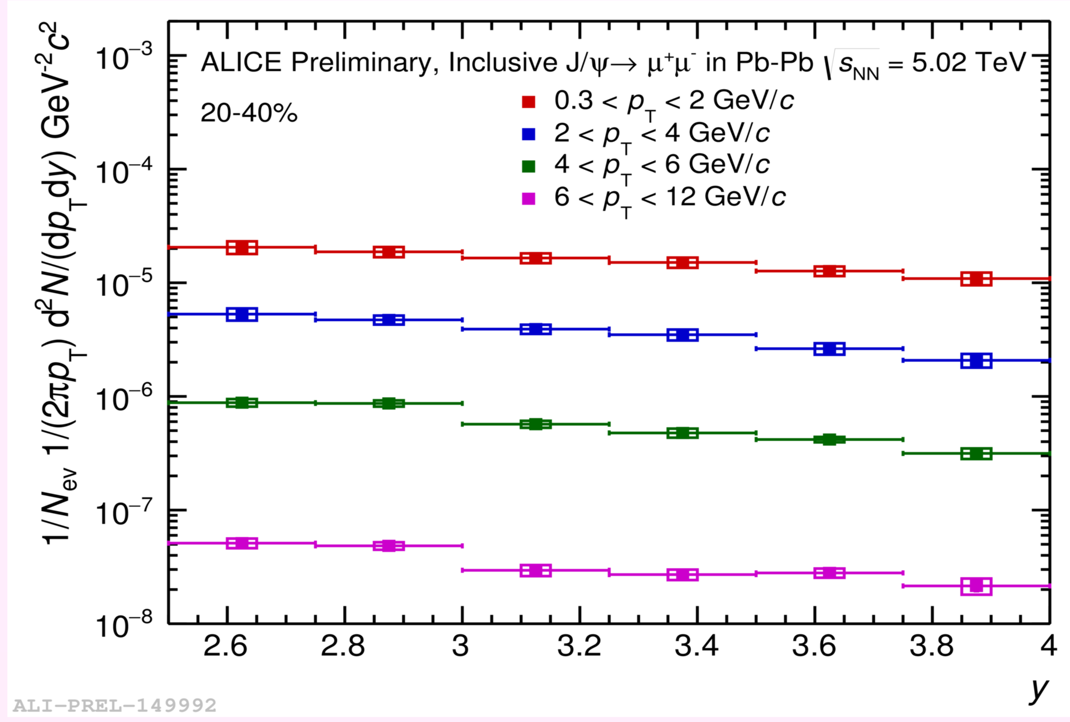

Figure 5 : J/ψ yield as a function of y in 20-40% centrality bin and p_{T}.

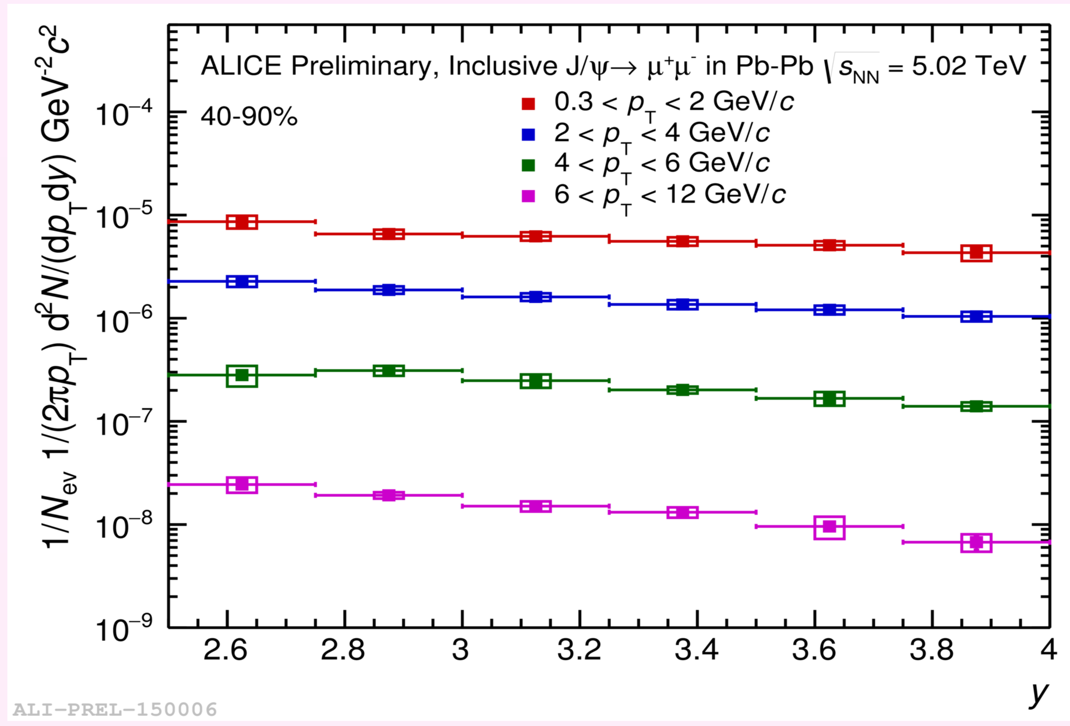

Figure 6 : J/ψ yield as a function of y in 40-90% centrality bin and p_{T}.

Rapidity slopes vs p_{T} in bins of centrality

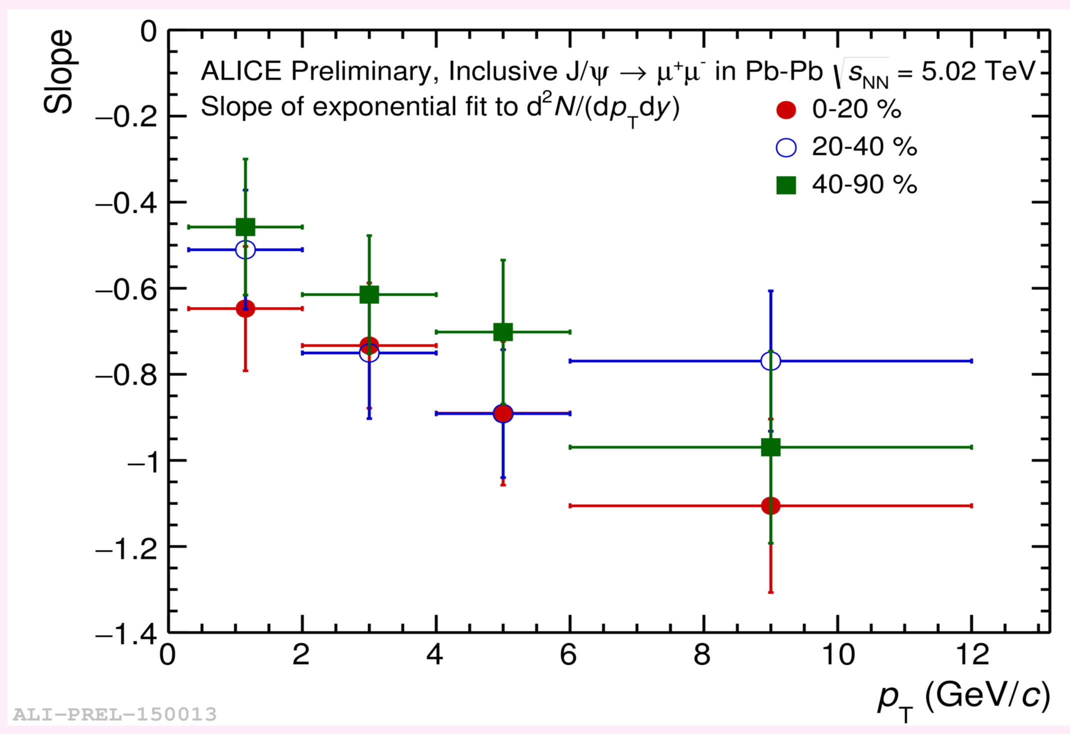

Figure 7 : Exponential slopes of a fit of J/ψ rapidity distribution.

The rapidity slope has been extracted by fitting the J/ψ yield by exponential function. The extracted slope parameters are found to decrease with p_{T} with little dependence on centrality.

Summary and conclusions

✓ The details of analysis technique for J/ψ yield as a function y in multi-differential bins are presented in this poster

✓ Signal extraction and $A \times \epsilon$ corrections have been evaluated for Pb-Pb collisions at $\sqrt{s_{\mathrm{NN}}} = 5.02$ TeV

✓ A variation of the rapidity slope as a function of p_{T} is observed .

✓ The yields as a function of rapidity are flatter at lower p_{T} while they drop faster with rapidity at high p_{T}

✓ This trend is qualitatively the same as in pp but a steeper slopes (narrow y distributions) is observed towards more central collisions

The 27th International Conference on Ultrarelativistic Nucleus-Nucleus Collisions, 13-19 May 2018, Venezia, Italy