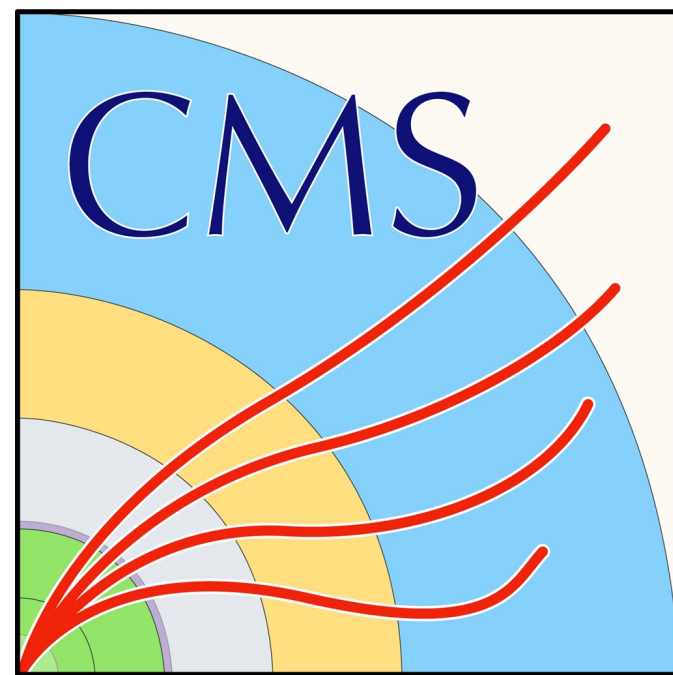


# Modification factor of $J/\psi$ & $\psi(2S)$

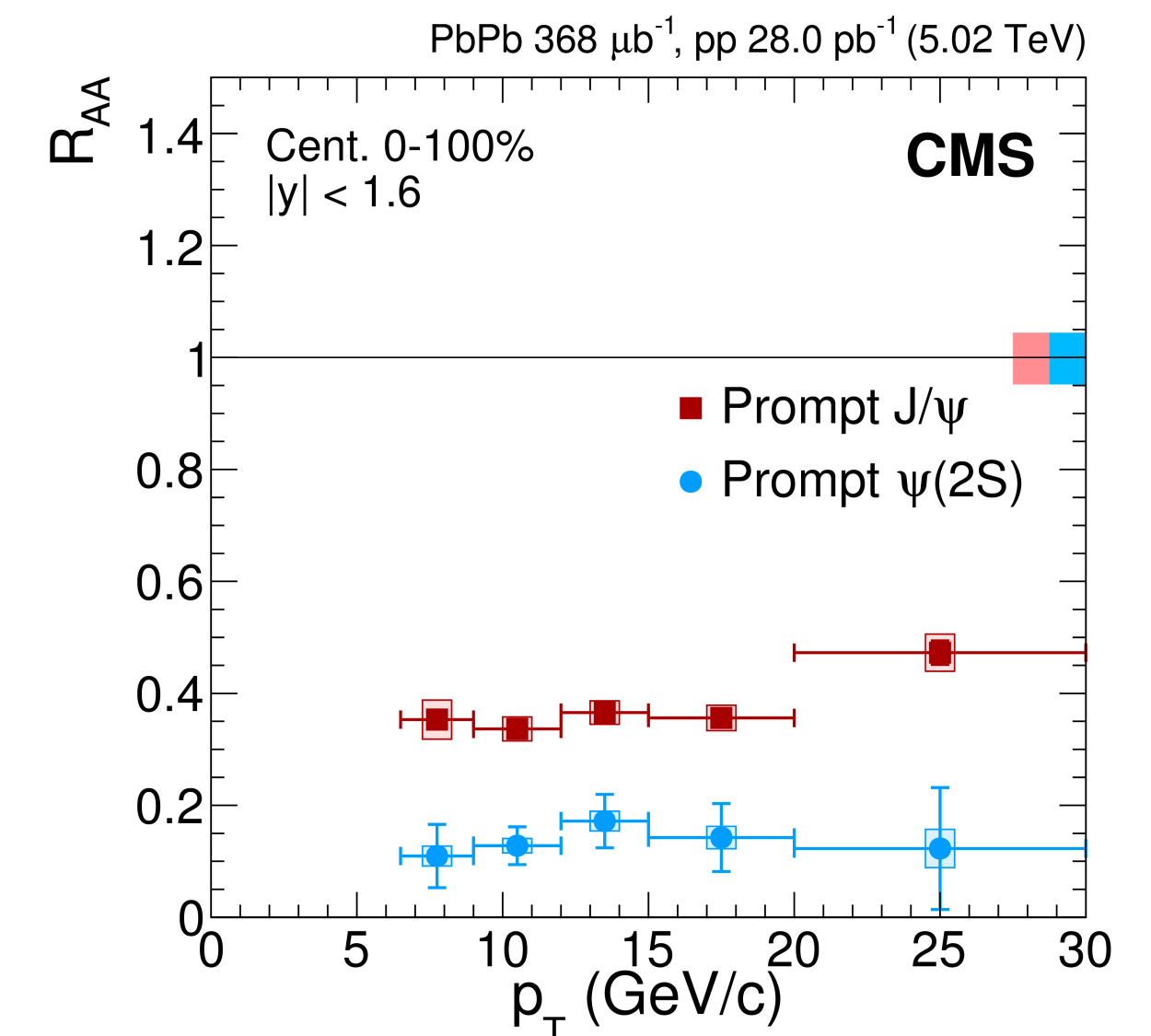
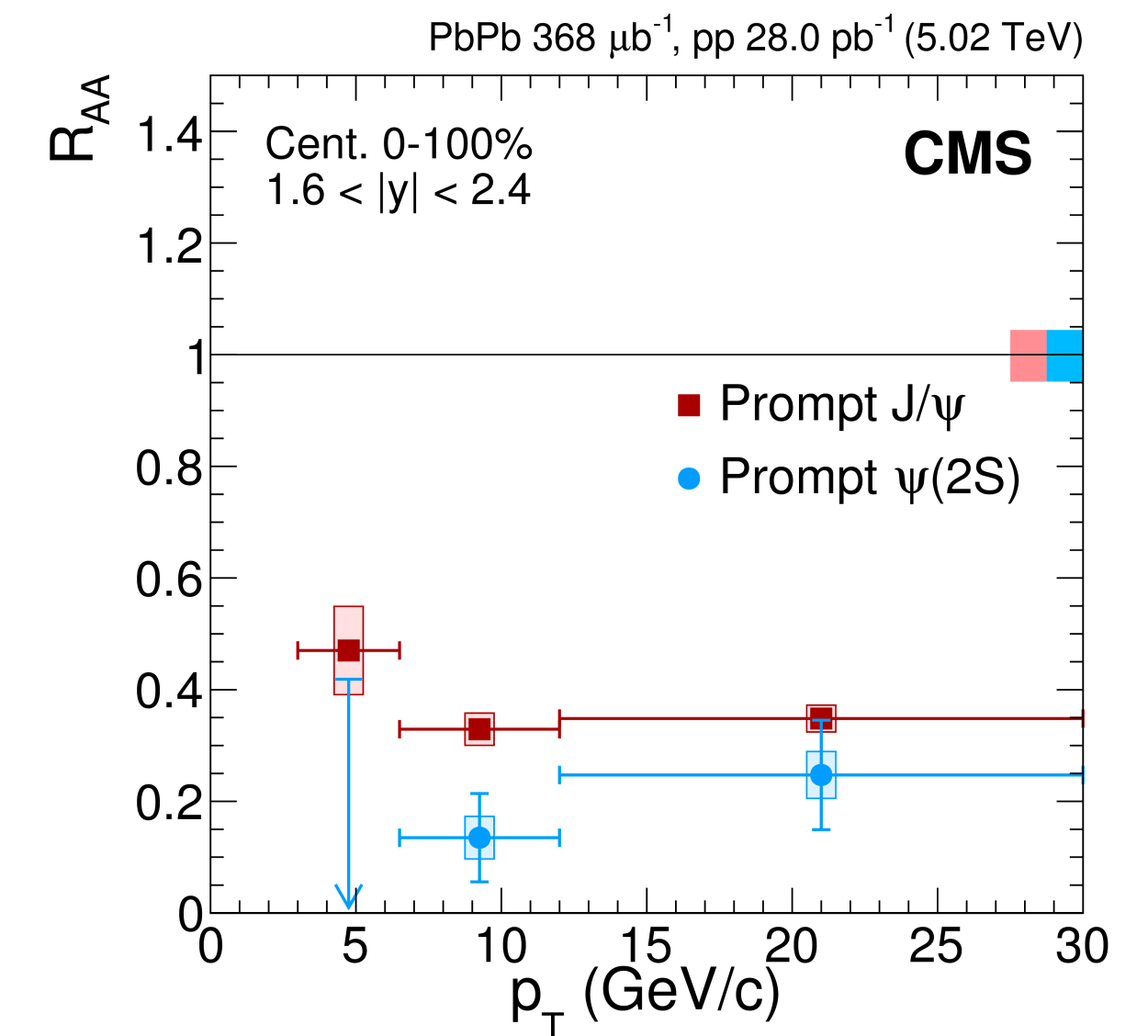


Gyeonghwan Bak, Dong Ho Moon,  
Hyunchul Kim, Piljun Gwak,  
Hanseul Lee, Junhu Seo  
(Chonnam National University)  
Soohwan Lee, Junseok Lee  
(Korea University)

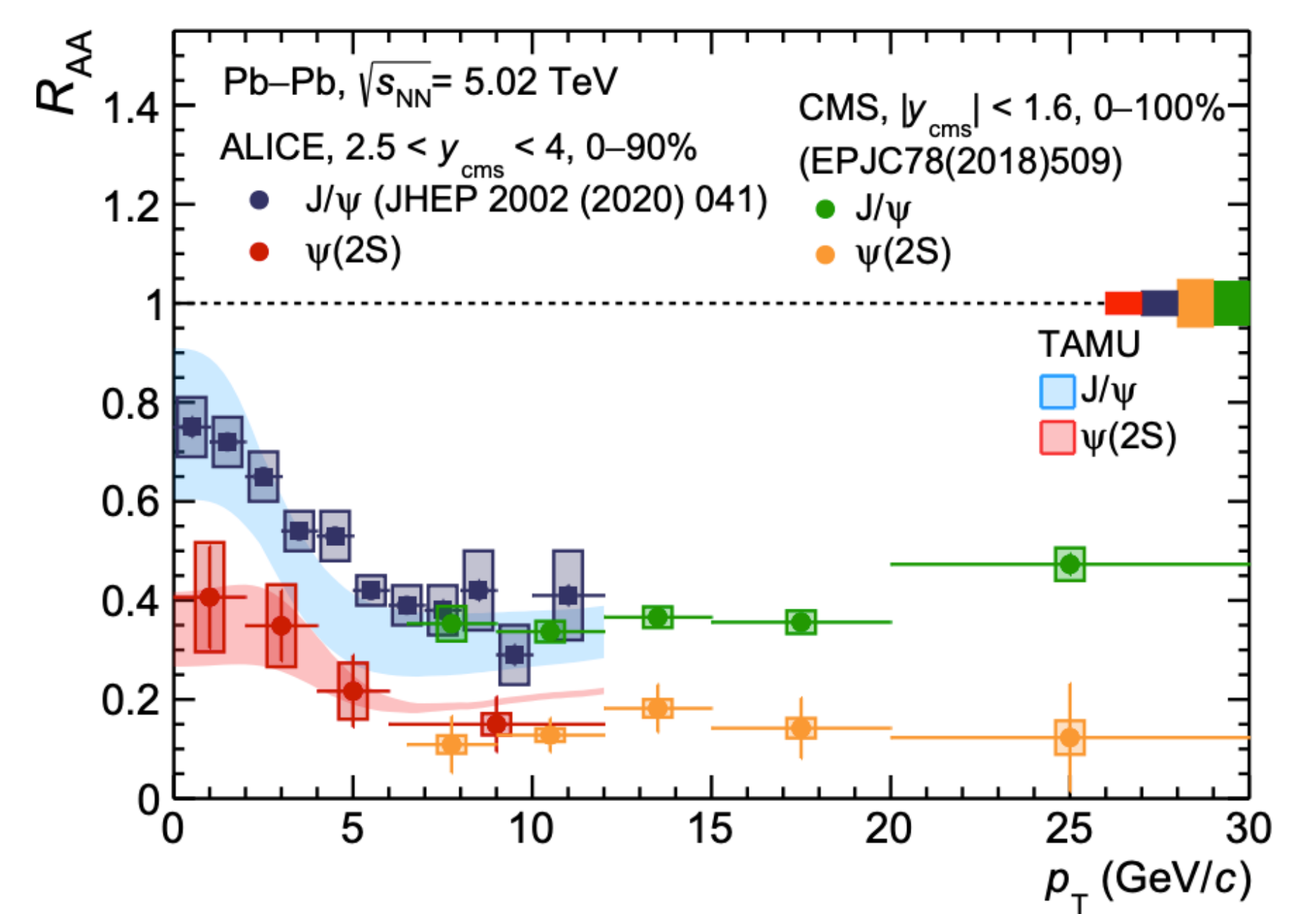
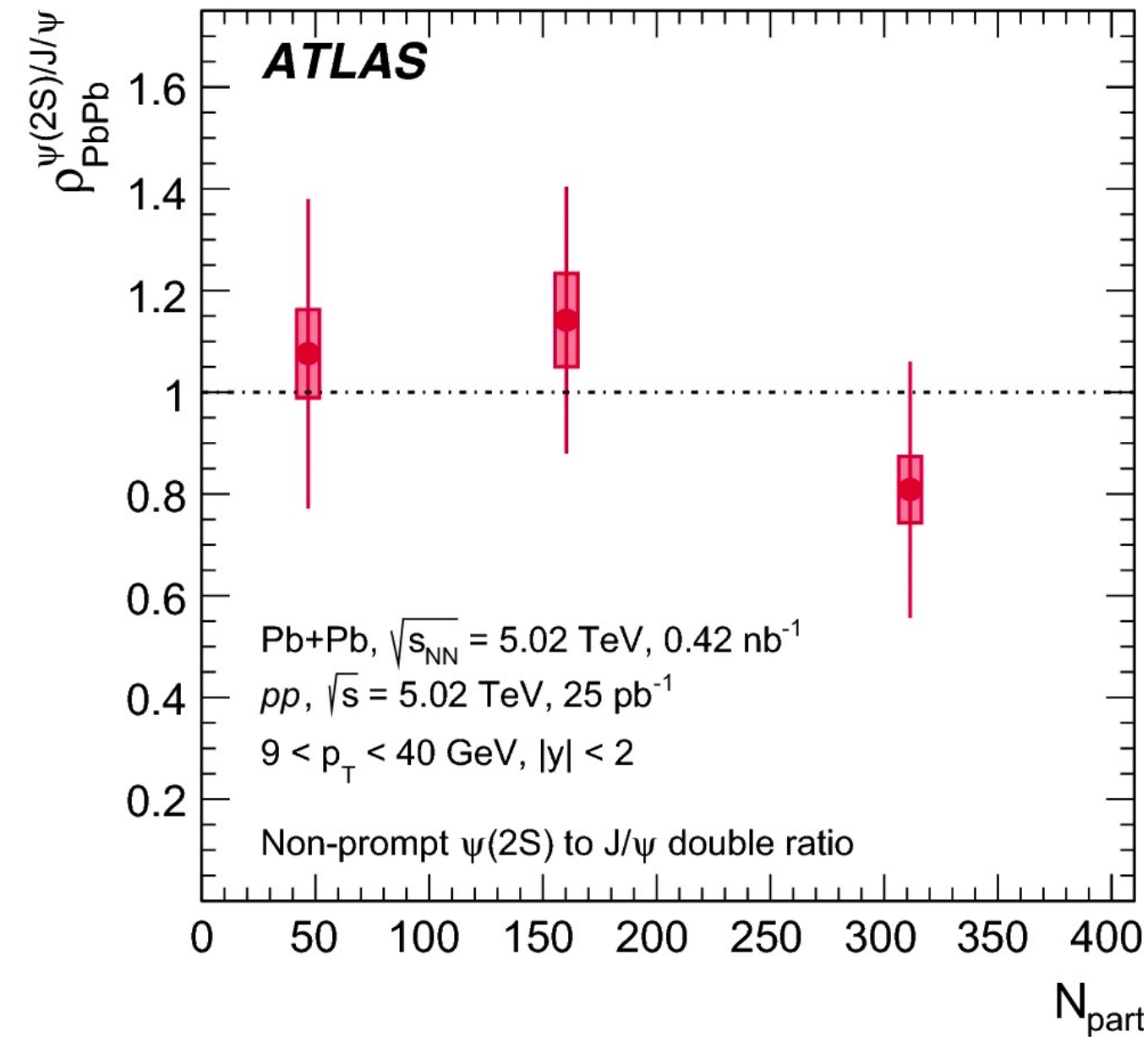
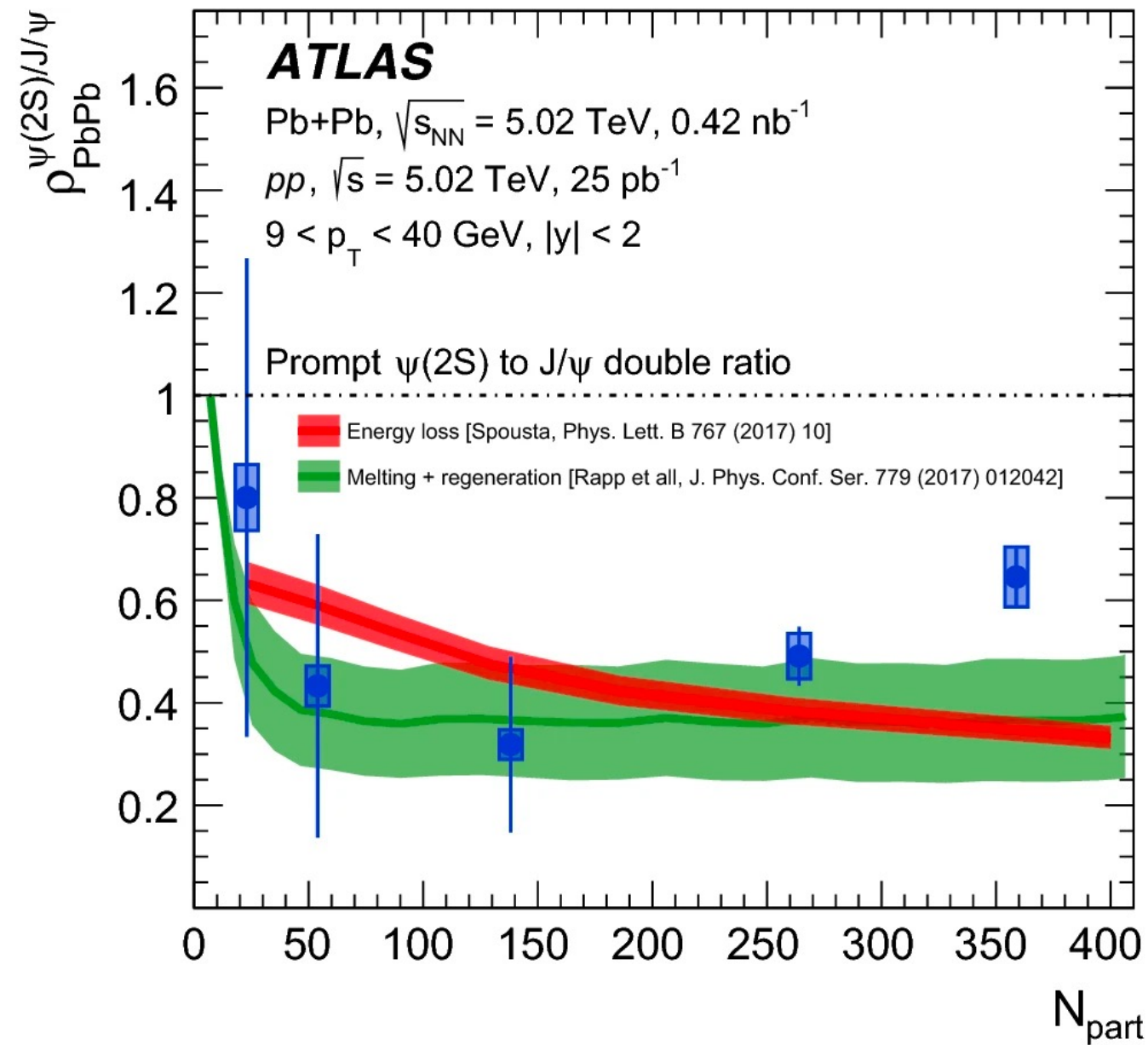


# Introduction

- Goal : measure modification factor of prompt and nonprompt  $J/\psi$  &  $\psi(2S)$  and also double ratio  $\psi(2S)$  to  $J/\psi$  in 2018 PbPb collision
- Manpower
  - Gyeonghwan Bak, Dong Ho Moon, Hyunchul Kim, Piljun Gwak, Hanseul Lee, Junhu Seo (CNU)
  - Soohwan Lee, Junseok Lee (KU)
- Motivation
  - The last result is still from HIN-16-025 (2015 PbPb data)
  - precision measurement with more statistics ( $1.61 \text{ nb}^{-1}$ )
  - Direct measurement of  $R_{AA}$  for  $\psi(2S)$



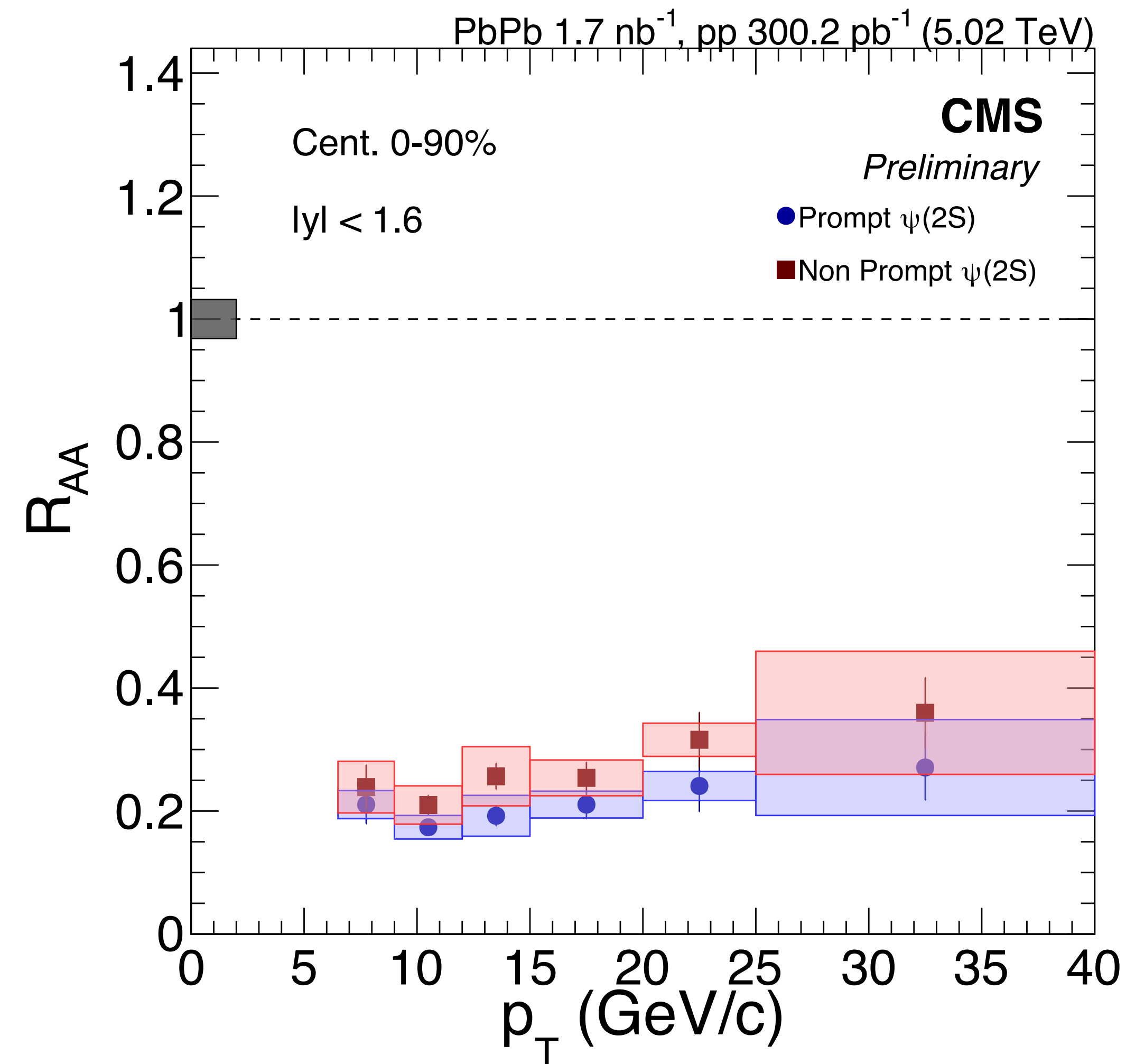
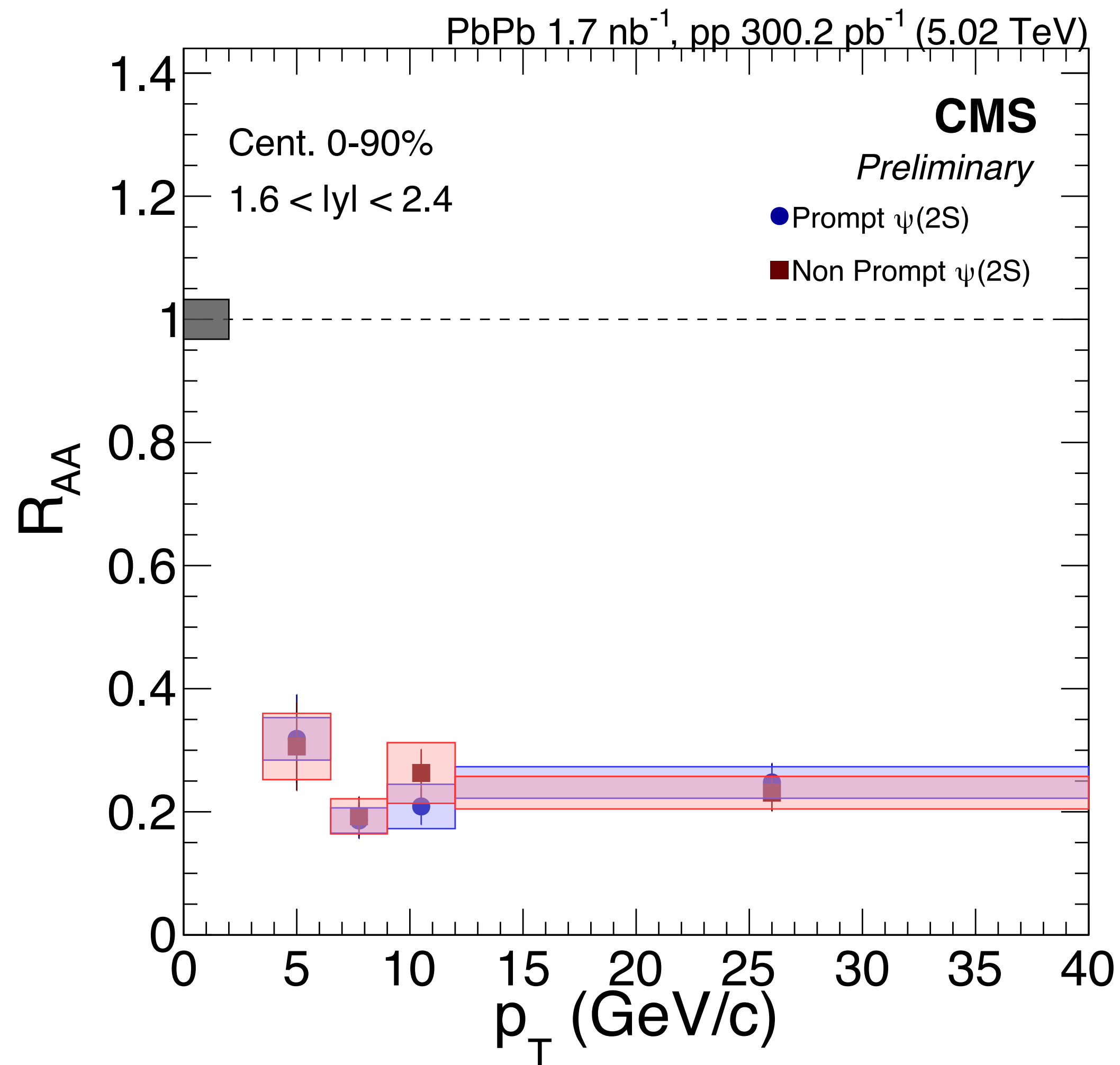
# Introduction



- ATLAS
  - $\psi(2S)$  to  $J/\psi$  double ratio for prompt and nonprompt
- ALICE
  - Inclusive  $\psi(2S)$  in low- $p_T$  bins
- CMS can separate prompt and nonprompt  $\psi(2S)$  by 2-Dimensional fit

# $\psi(2S)$ Results

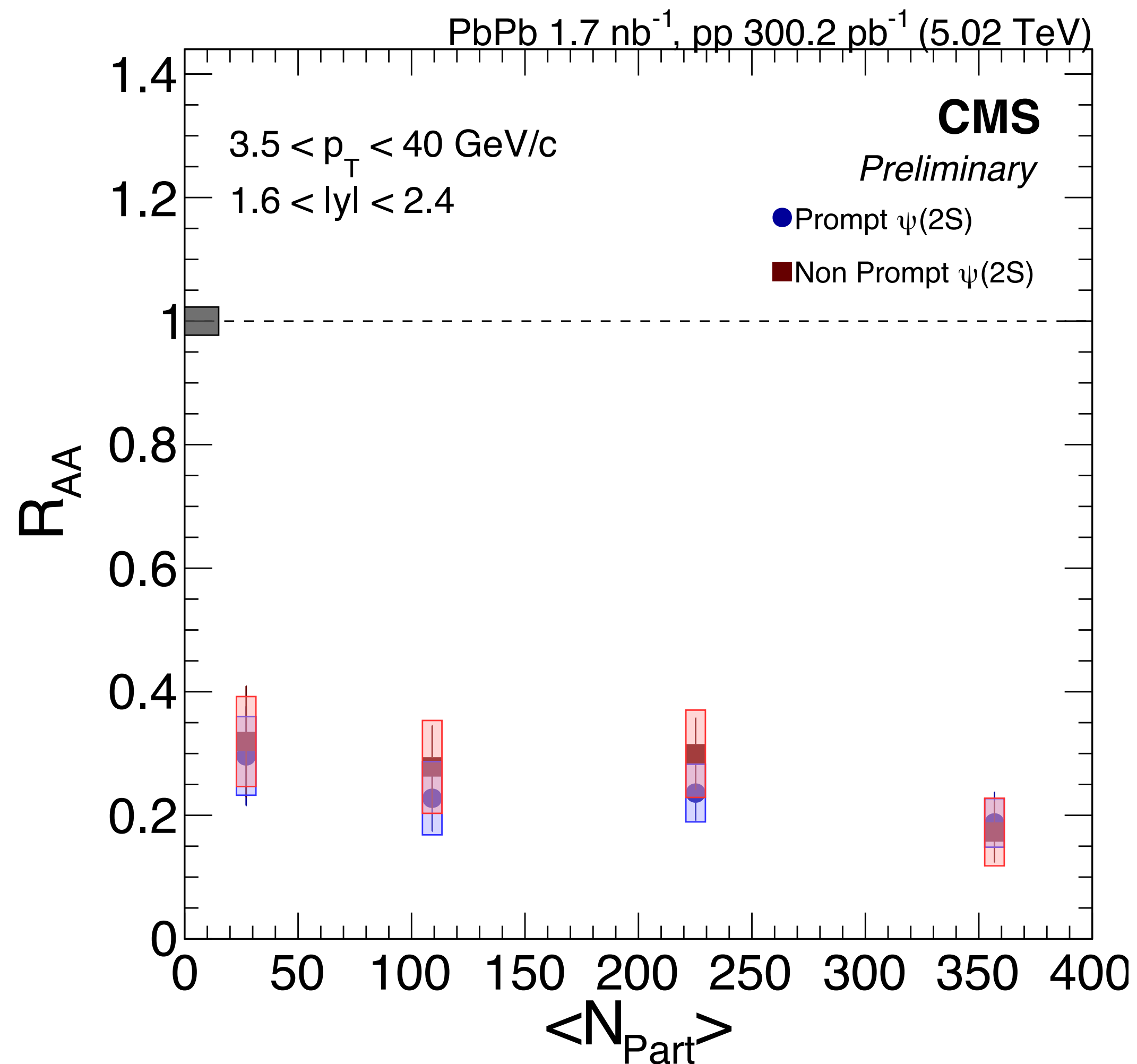
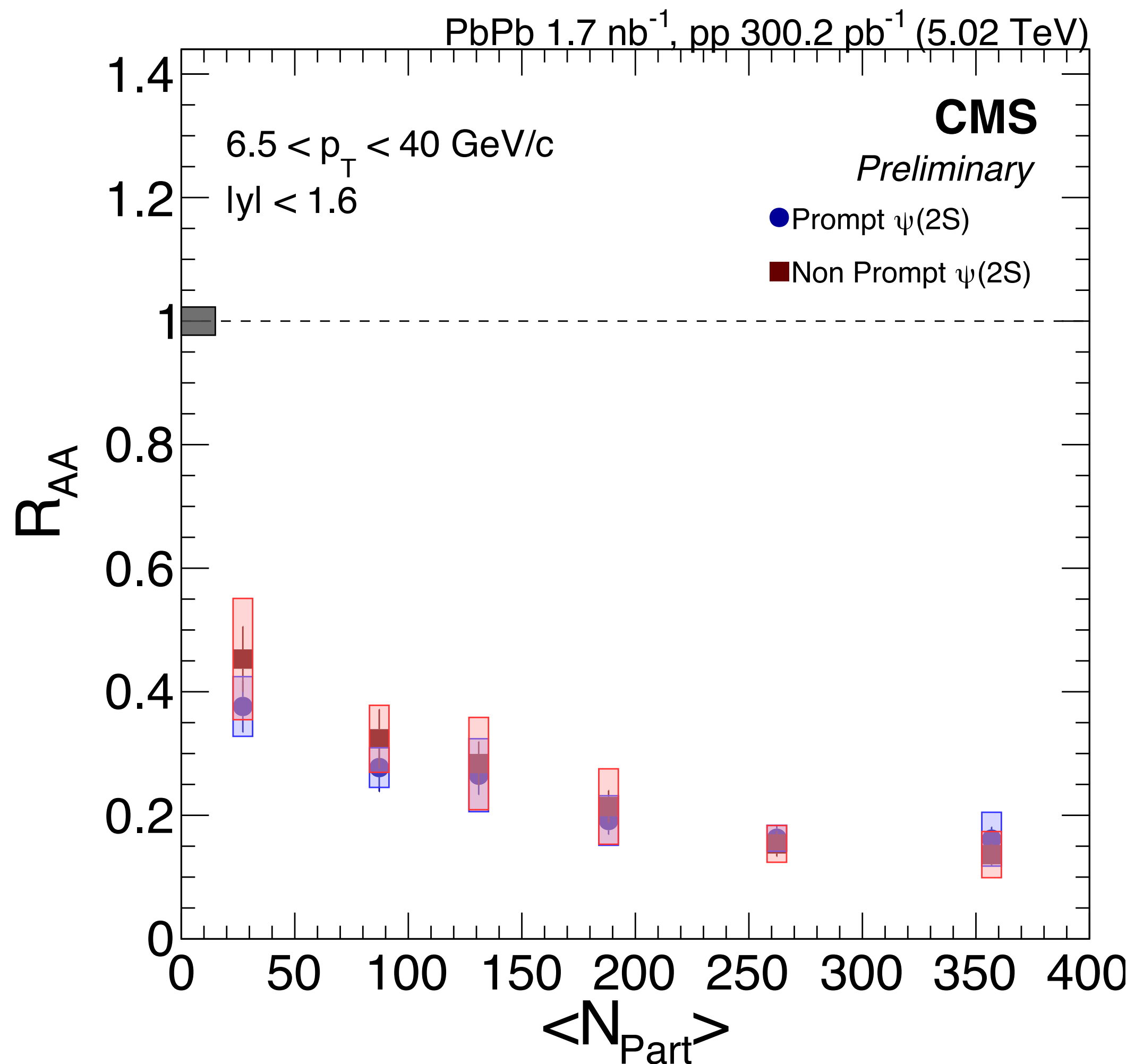
# $\psi(2S)$ $R_{AA}$ vs $p_T$



- The  $R_{AA}$  values seem to be increasing as increasing  $p_T$  for  $|y| < 1.6$  but flat in  $1.6 < |y| < 2.4$
- Maybe increasing lower  $p_T$  : hint of regeneration effect

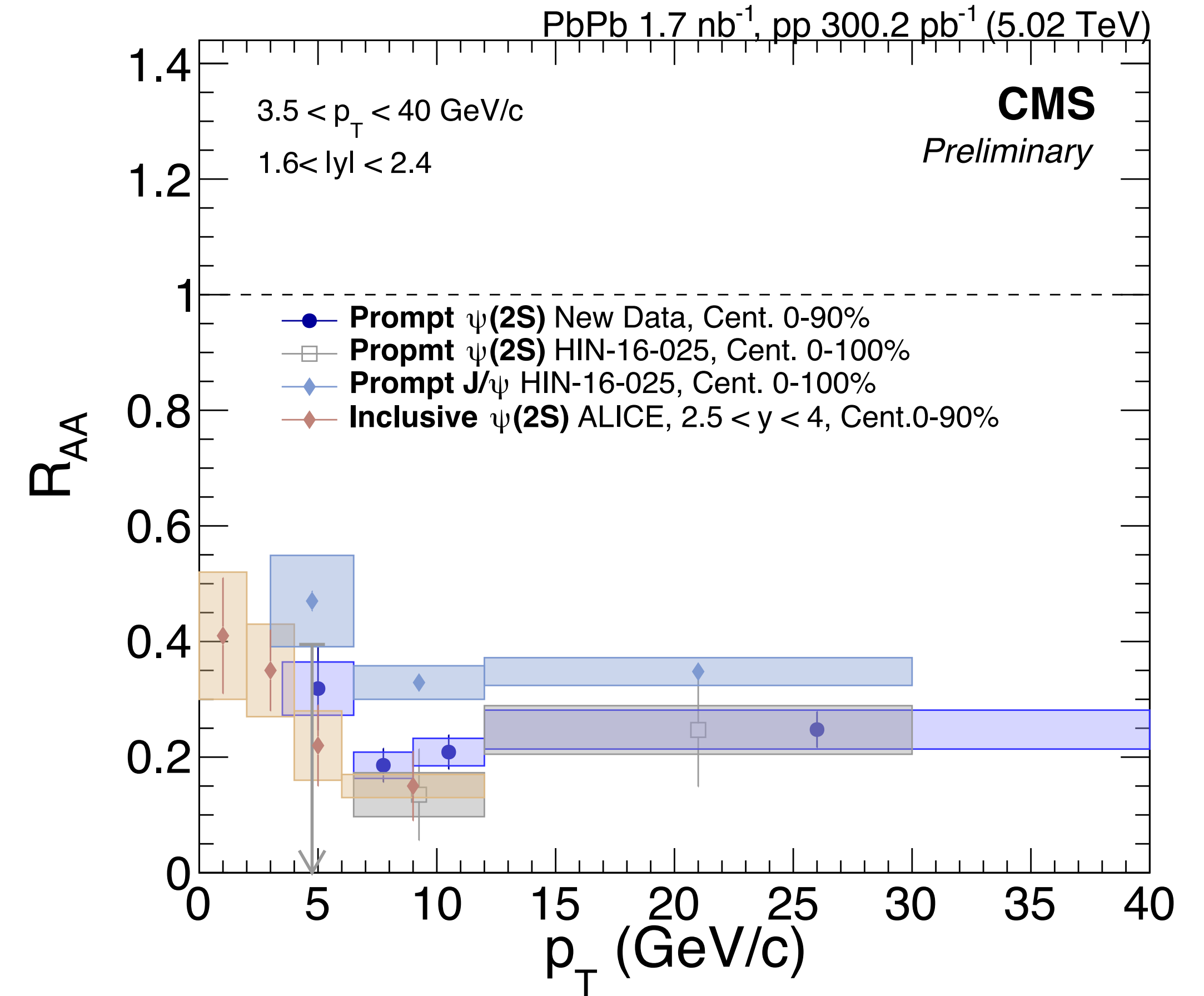
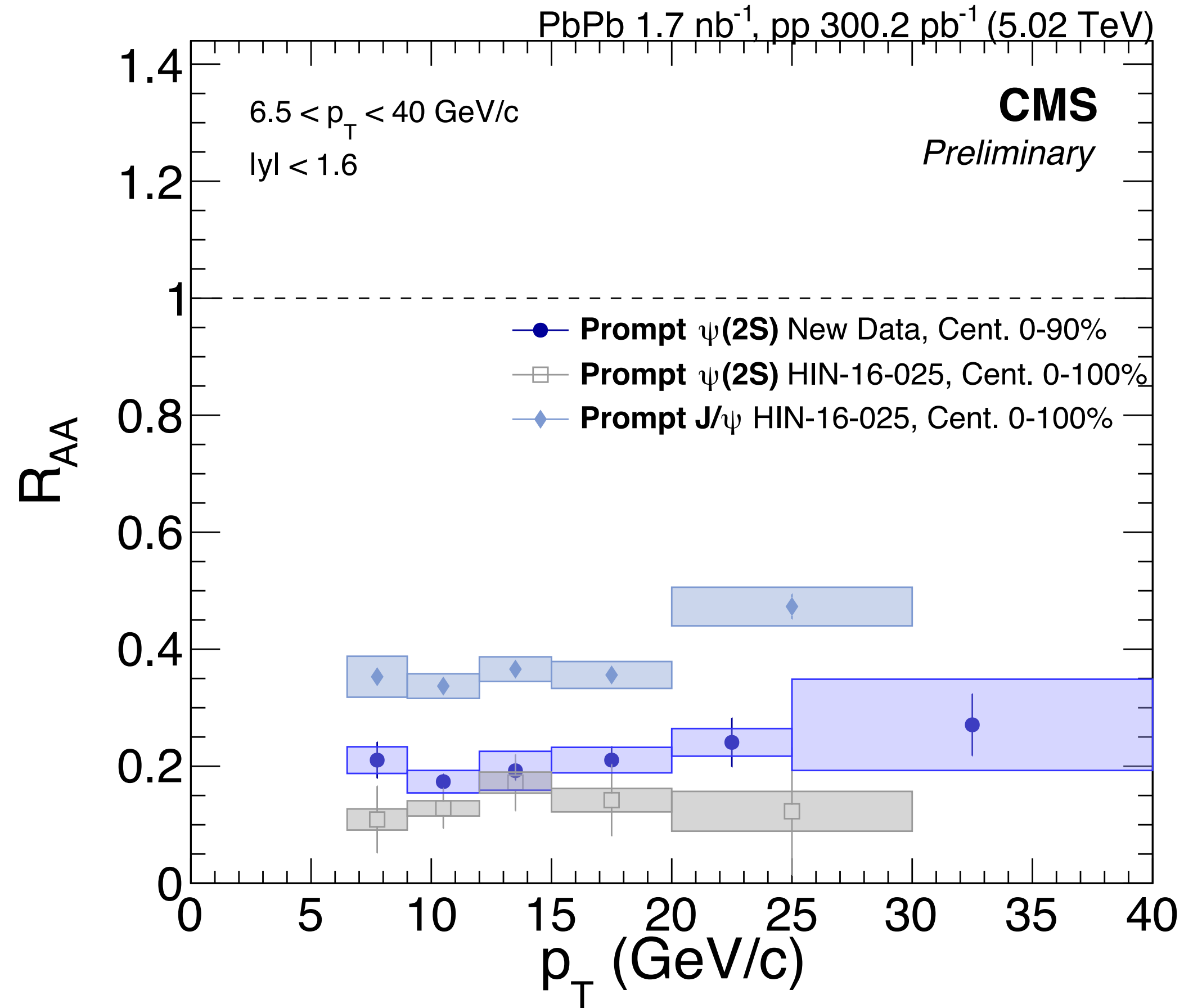


# $\psi(2S)$ $R_{AA}$ VS $\langle N_{Part} \rangle$



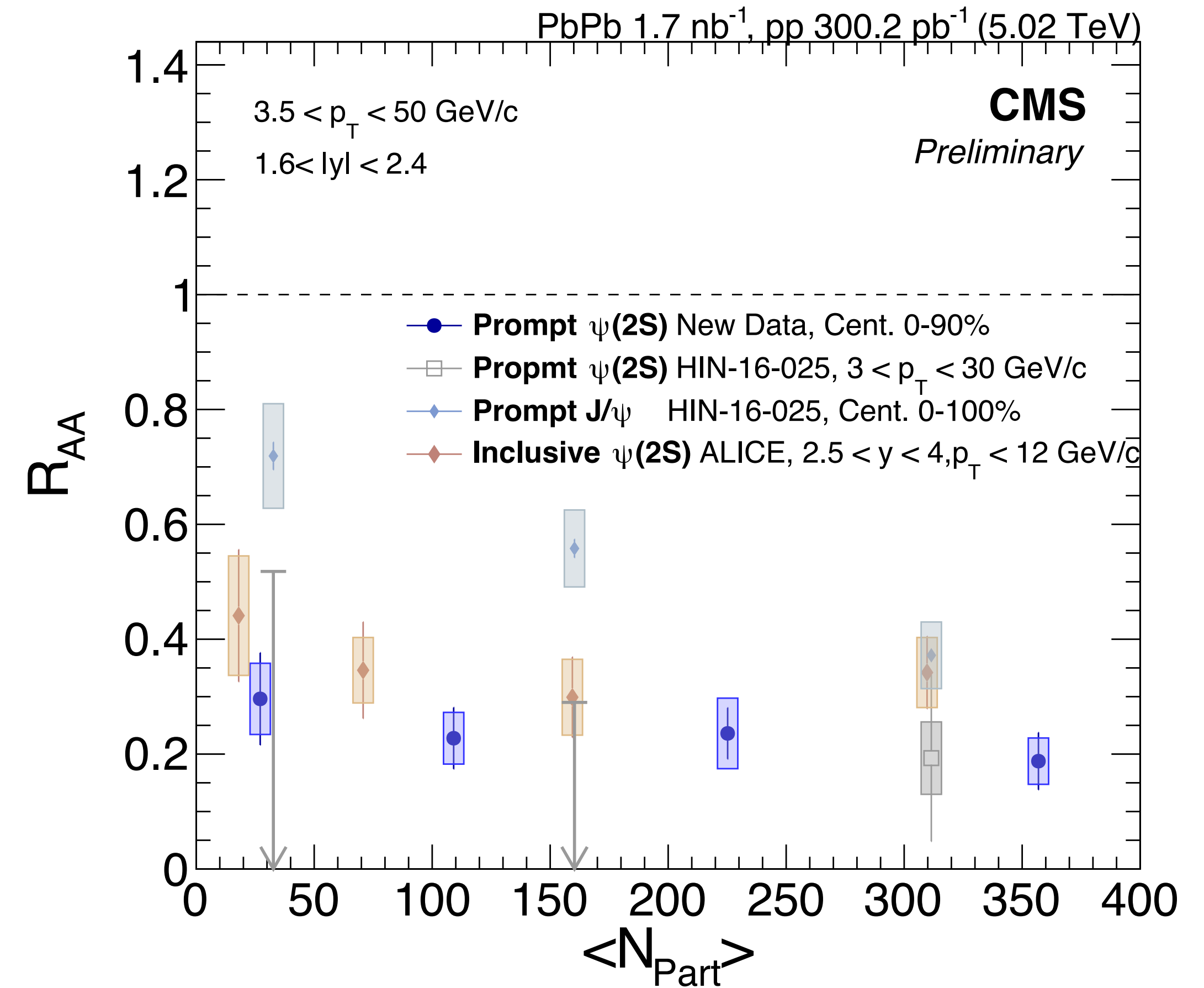
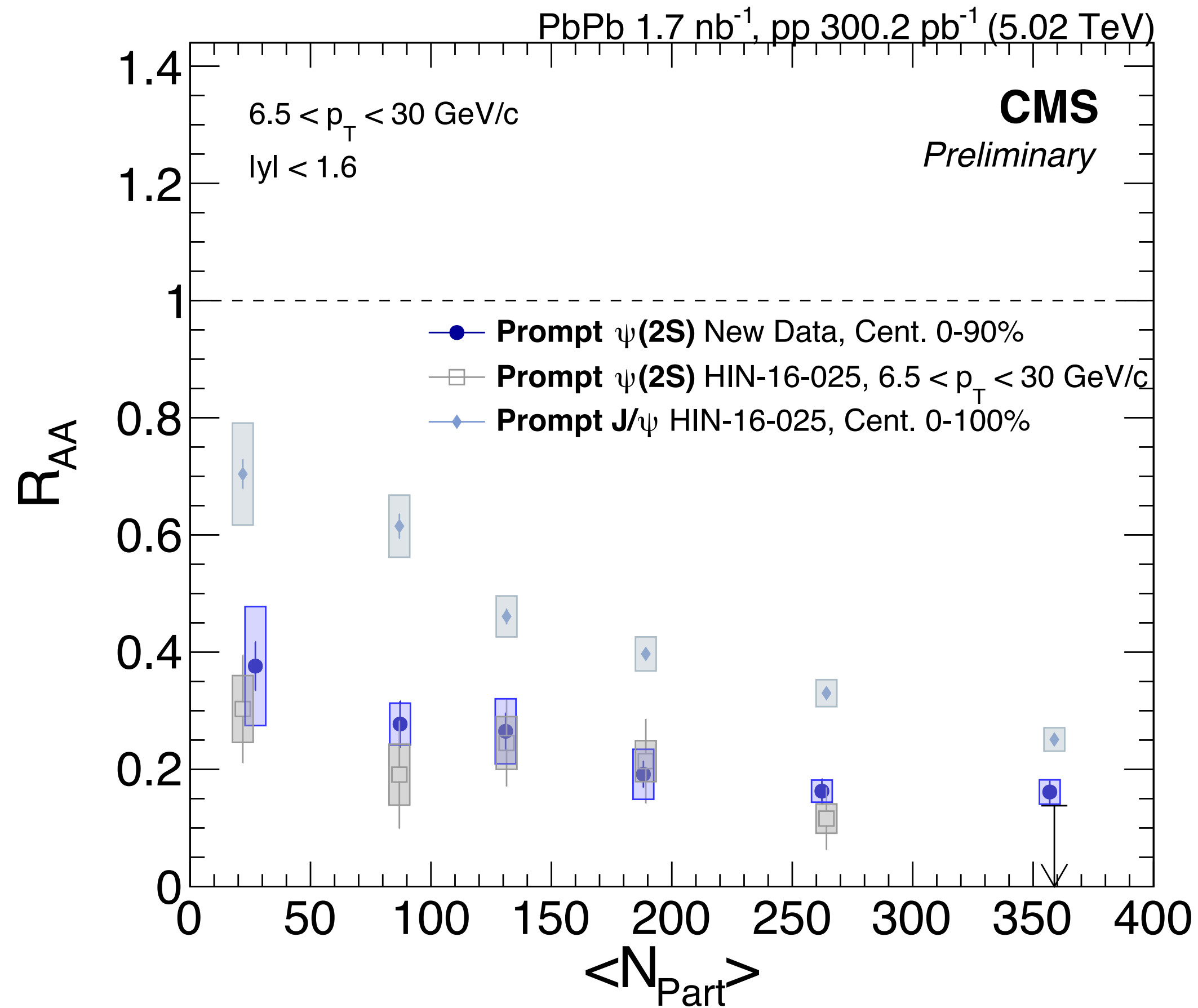
- $R_{AA}$  show the strong dependence on centrality in mid rapidity, while looks flat in forward and lower  $p_T$
- Nonprompt  $\psi(2S)$   $R_{AA}$  are measured directly for the first time with sizable uncertainties

# Compare to previous results



- $R_{AA}$  values of prompt  $\psi(2S)$  looks compatible with previous results
- $R_{AA}$  values of lowest  $p_T$  in forward rapidity slightly larger than ALICE result

# Compare to previous results

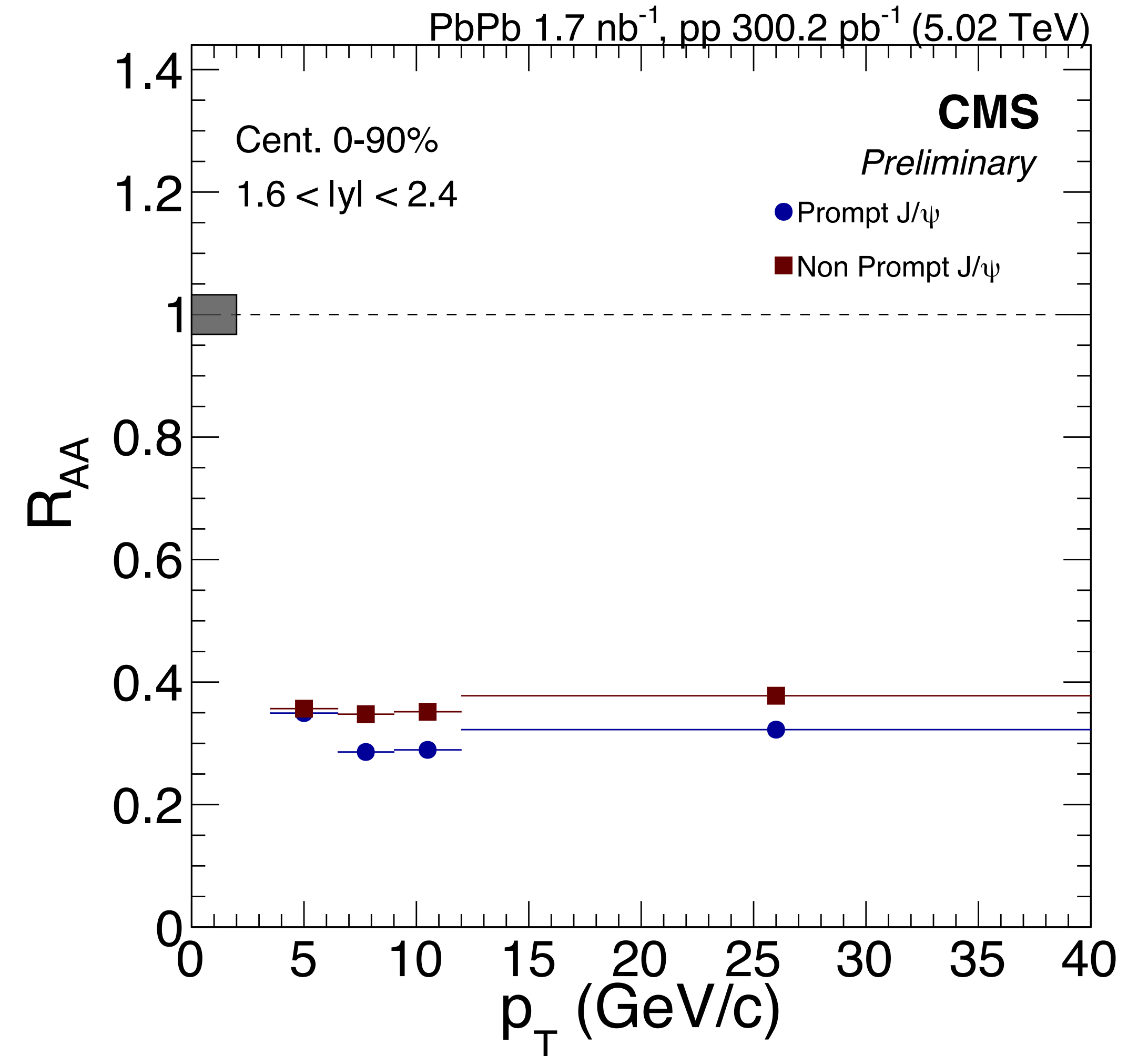
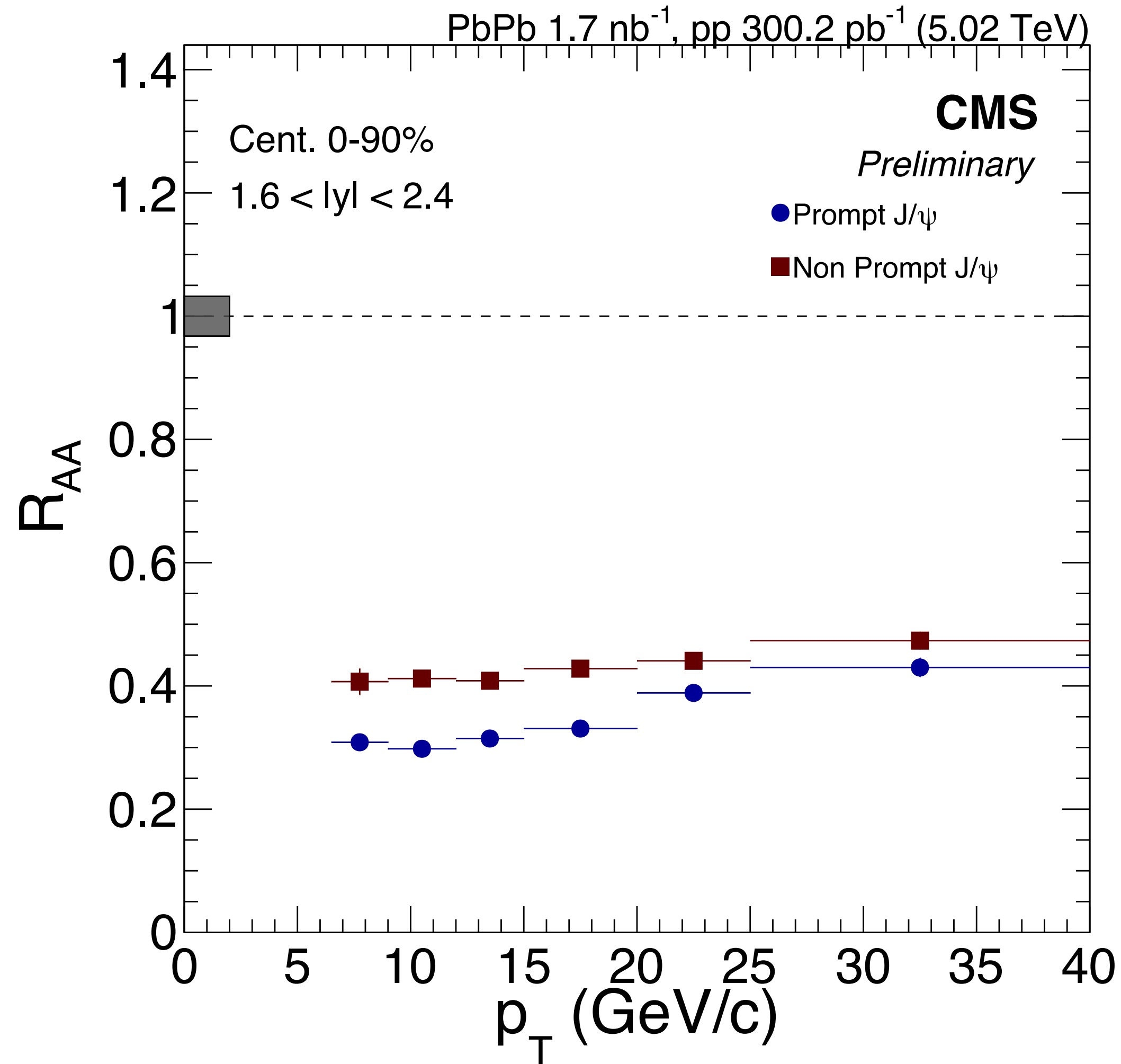


- $R_{AA}$  values of prompt  $\psi(2S)$  looks compatible with previous results
- $R_{AA}$  measurements are possible due to larger statistics in the region where presented by the upper limits in the previous measurements



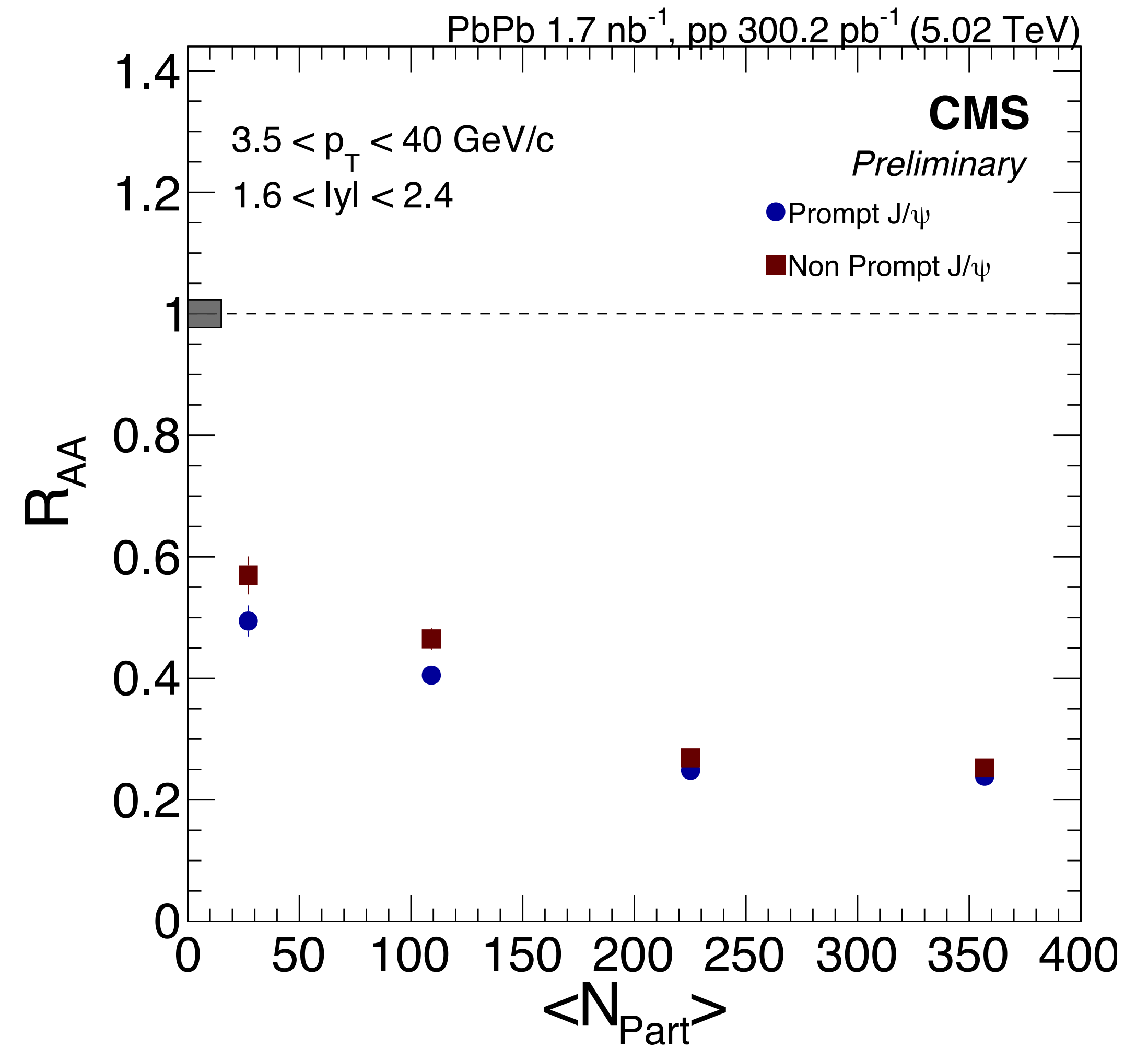
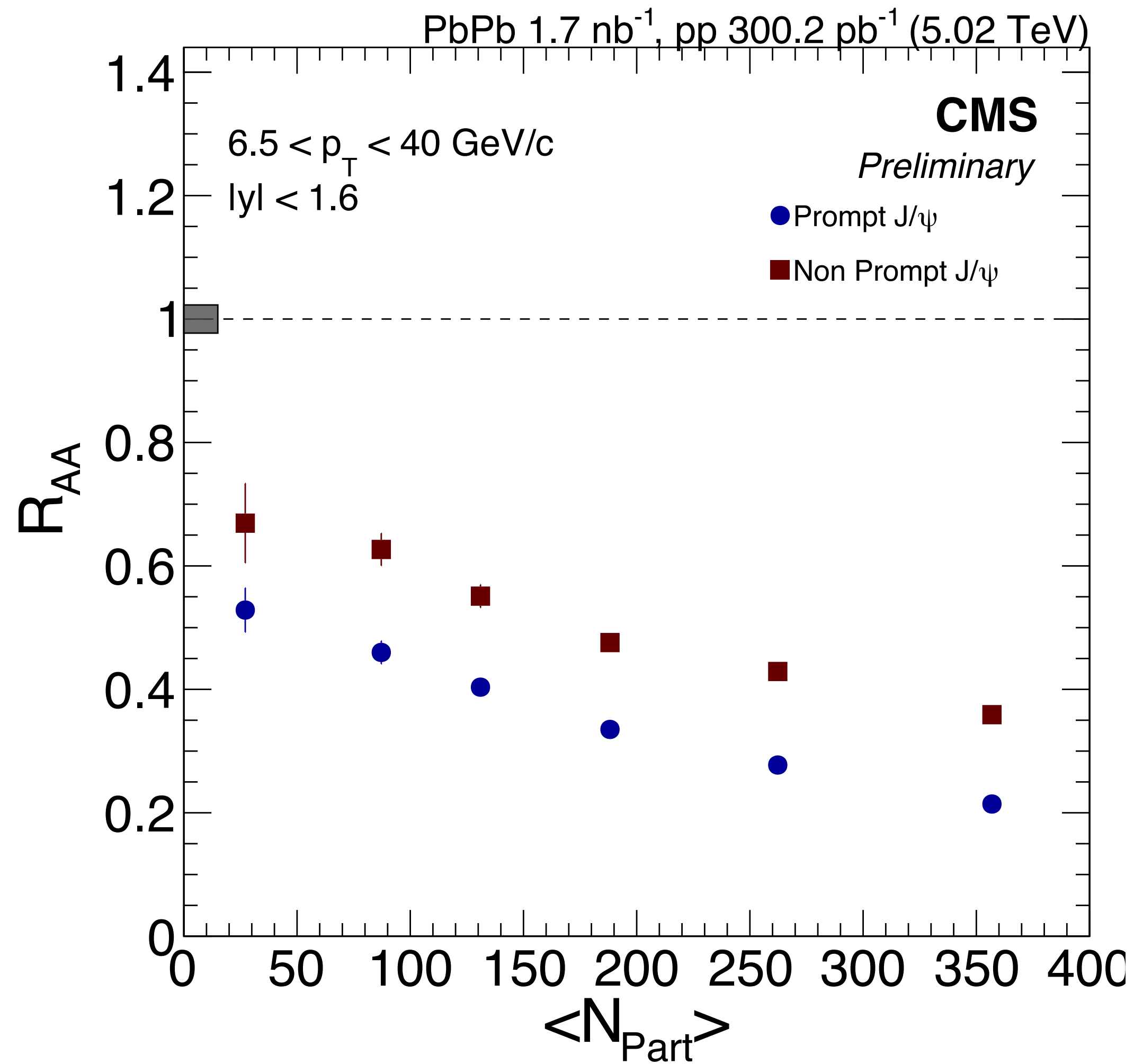
# $J/\psi$ Results

# J/ψ R<sub>AA</sub> vs p<sub>T</sub>



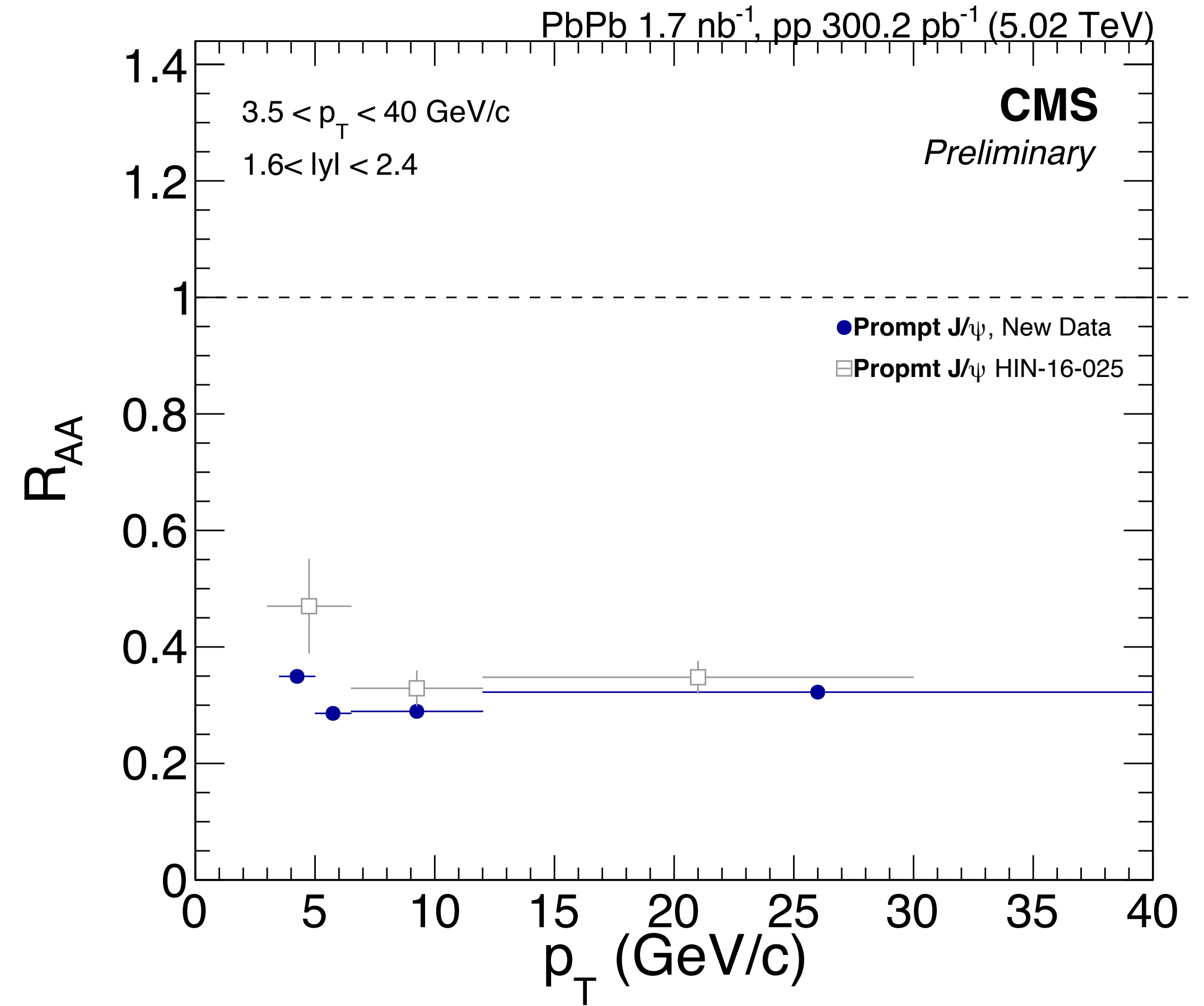
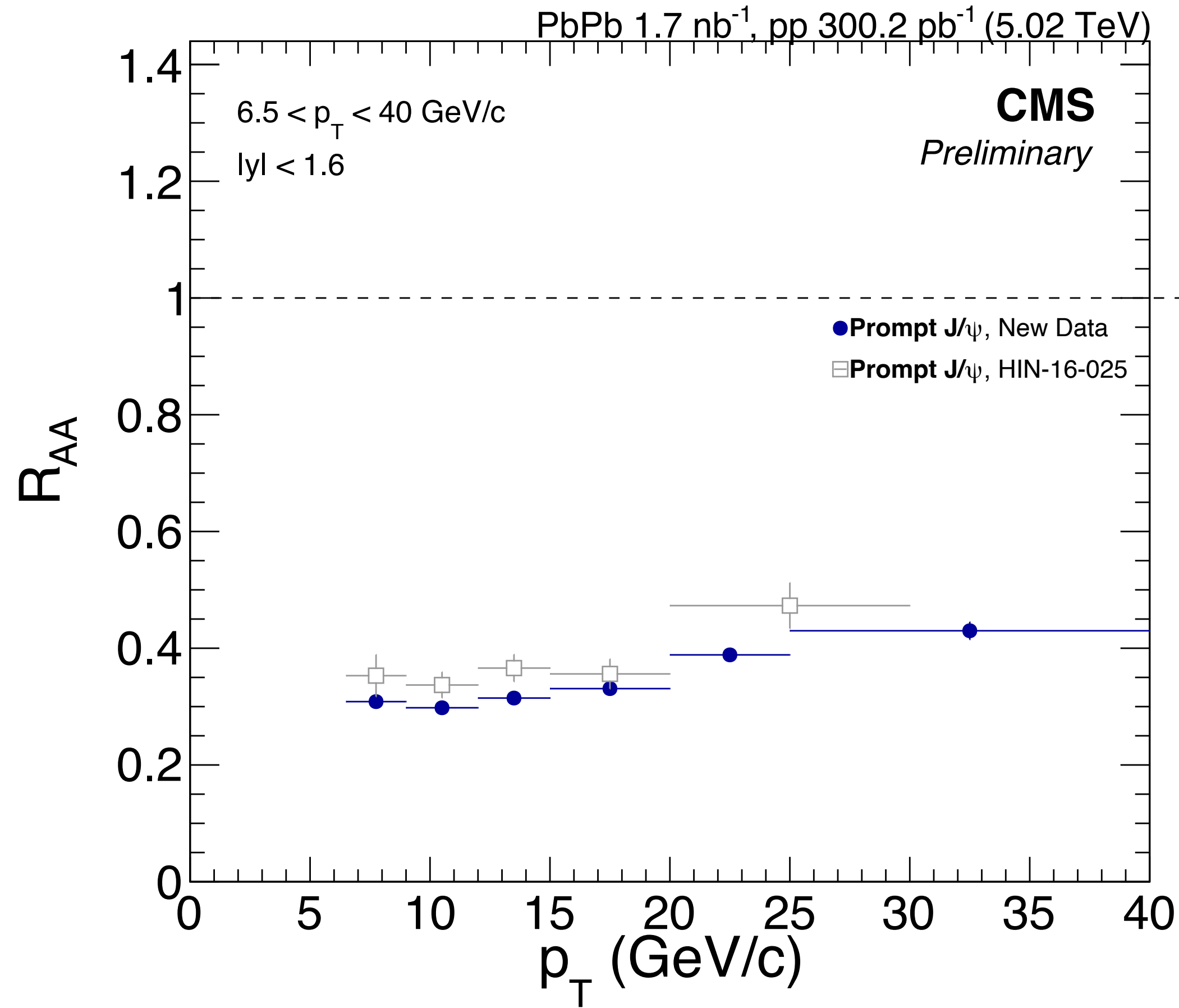
- The prompt R<sub>AA</sub> values seem to be increasing as increasing p<sub>T</sub> for |y| < 1.6 but flat in 1.6 < |y| < 2.4 except lowest bin
- The nonprompt values flat in both rapidity region

# $J/\psi$ $R_{AA}$ VS $\langle N_{Part} \rangle$



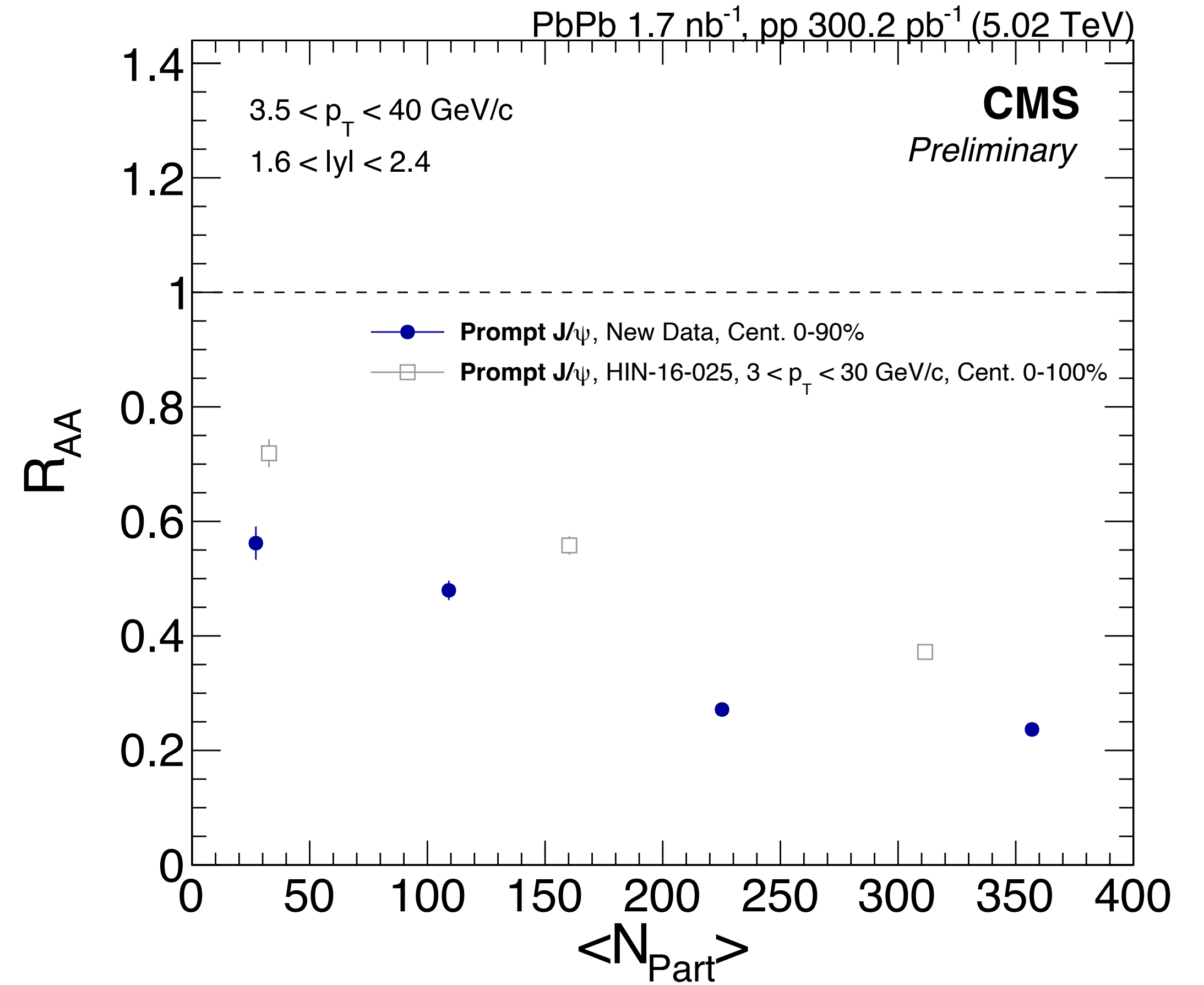
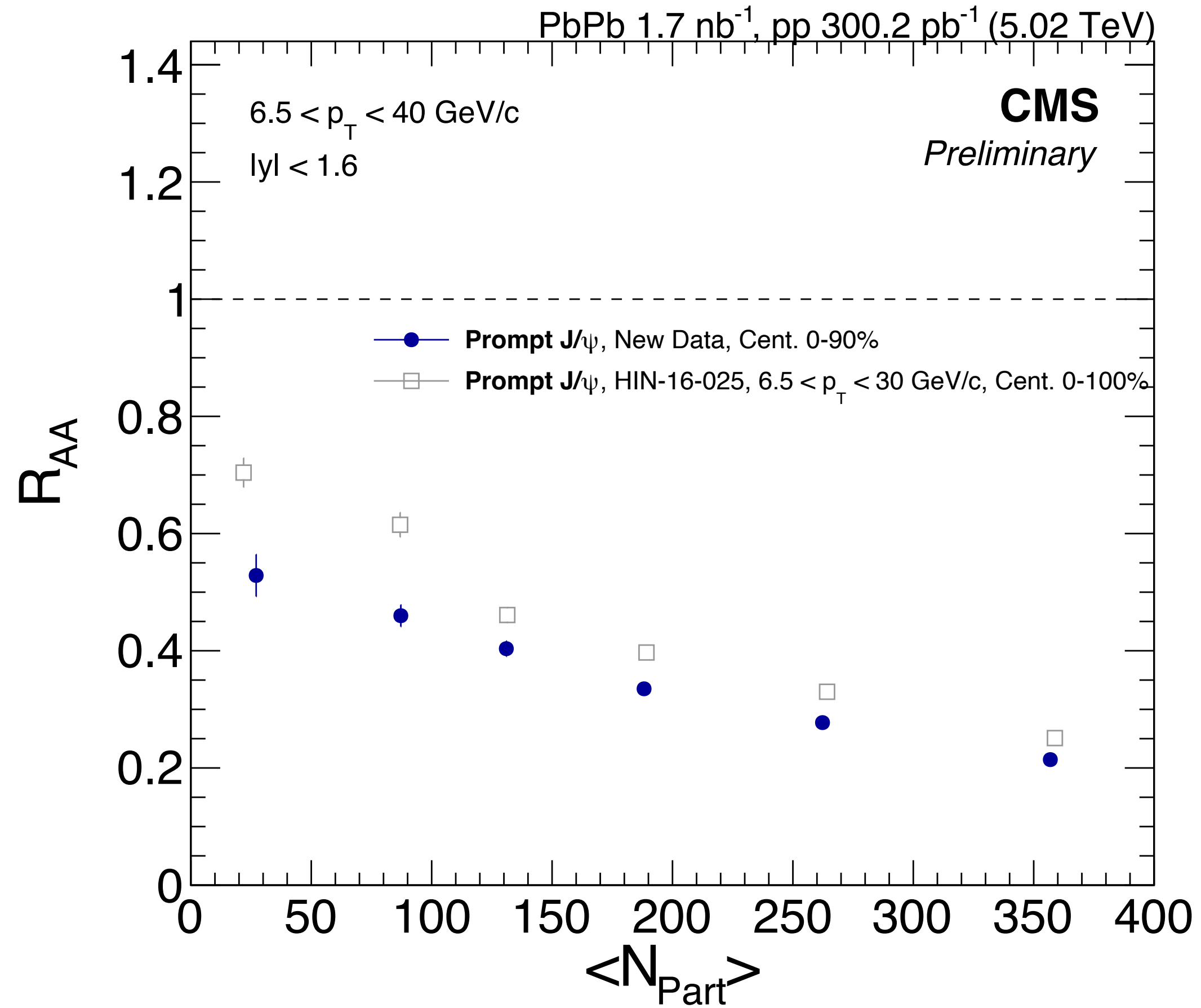
- The prompt and nonprompt  $R_{AA}$  show the strong dependence on centrality in both rapidity region

# Compare to previous results



- The prompt R<sub>AA</sub> values of J/ψ looks compatible with previous results from HIN-16-025 within error bar

# Compare to previous results

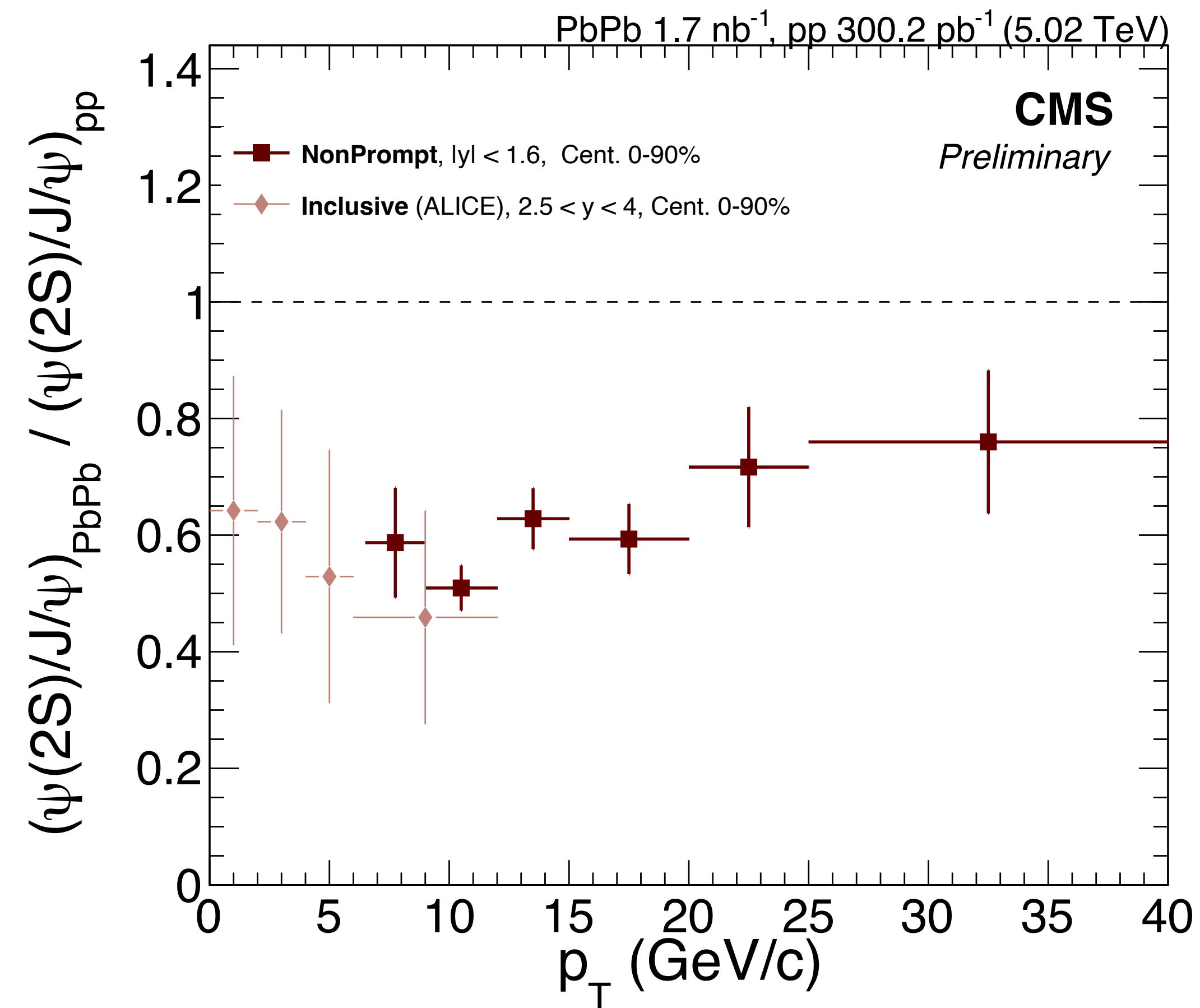
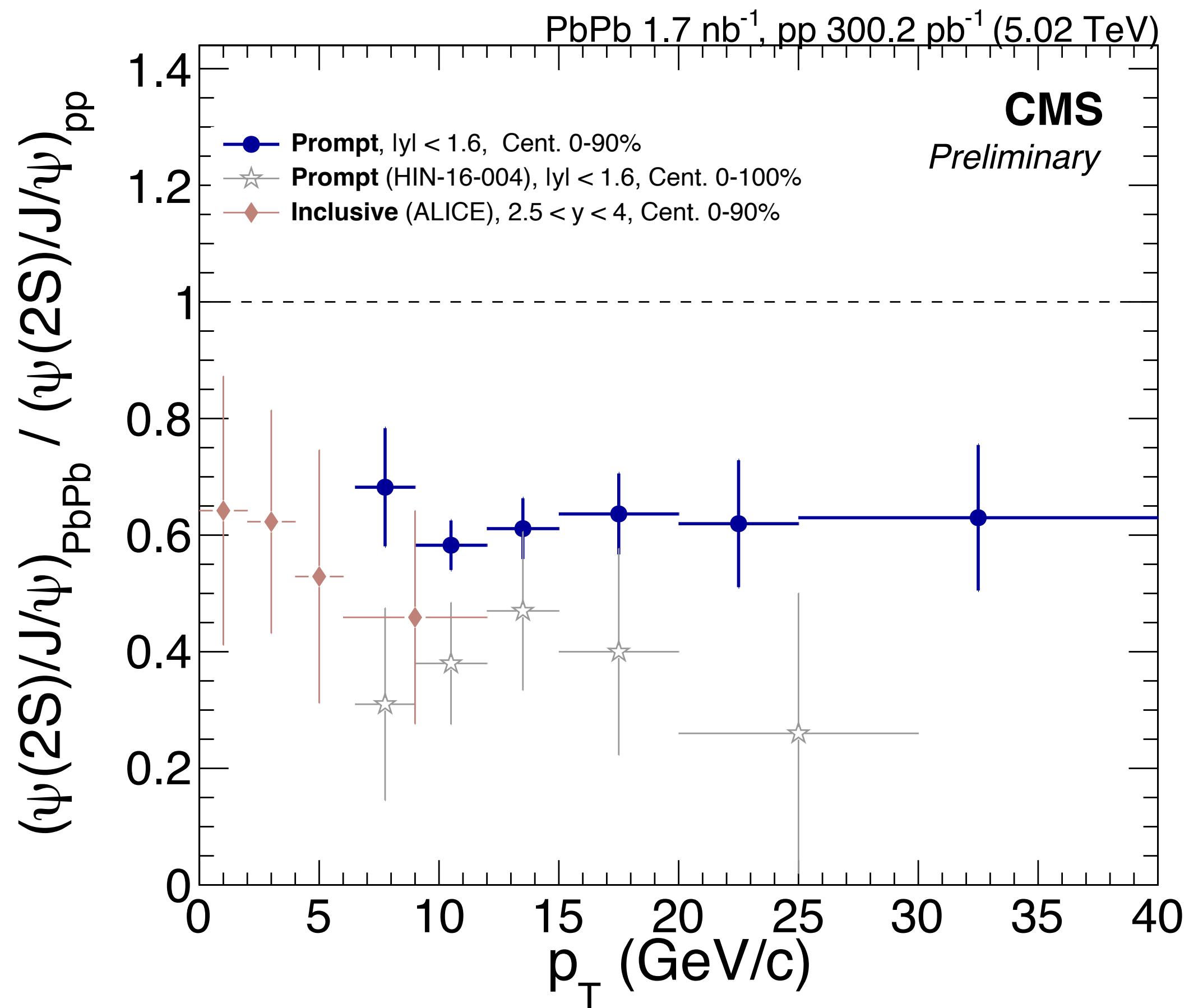


- The R<sub>AA</sub> values vs. <N<sub>Part</sub>> are different from previous results



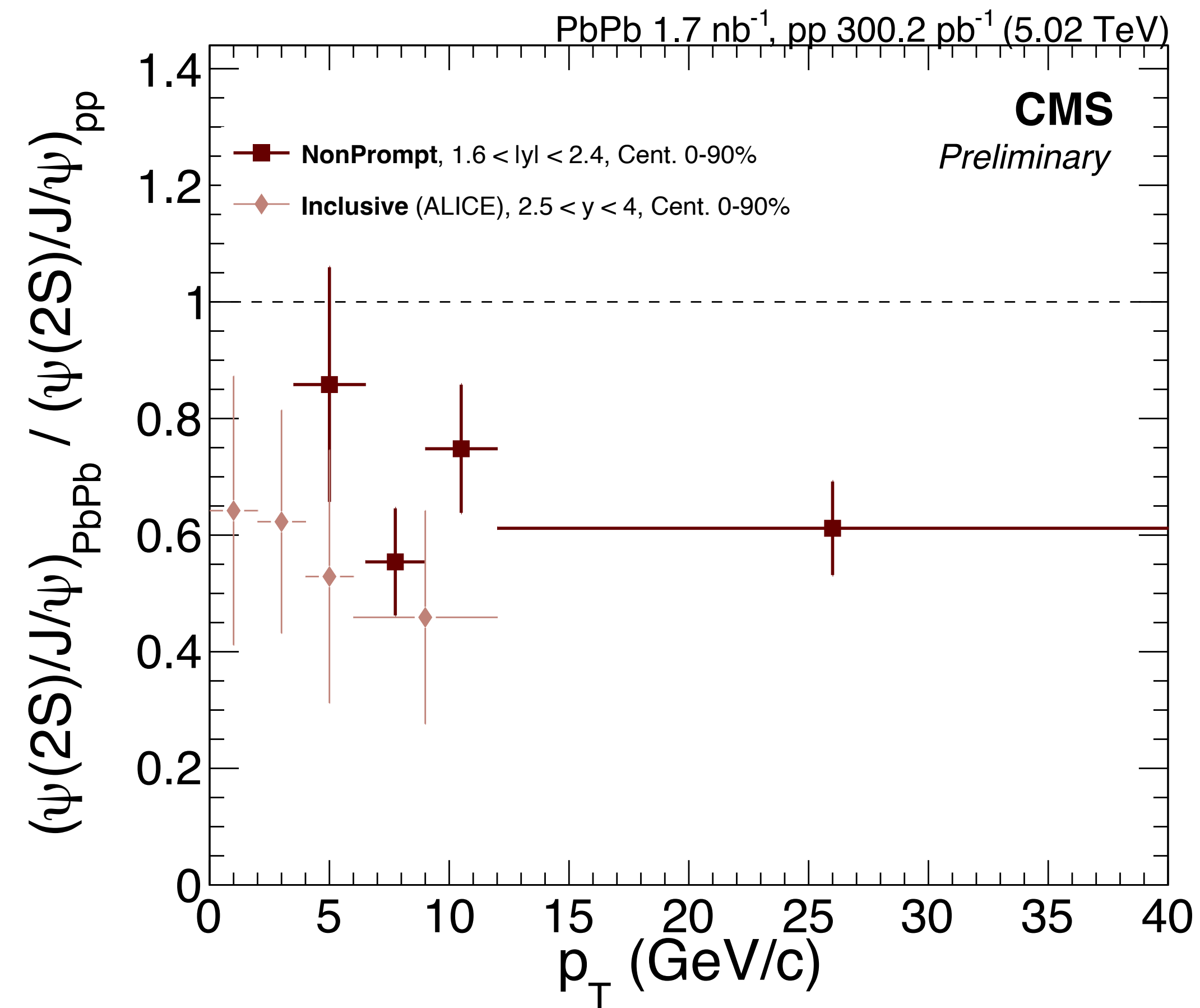
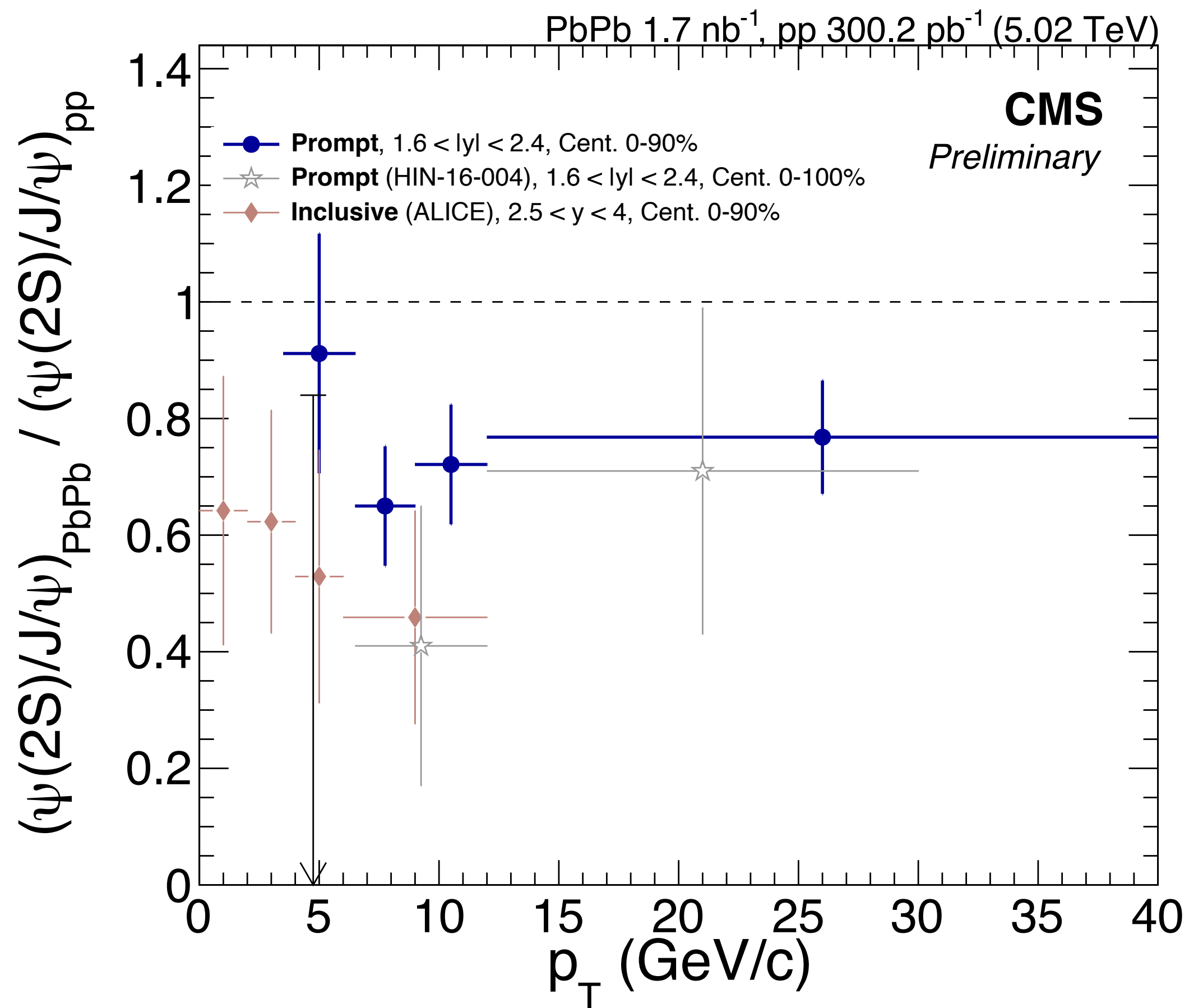
# Double Ratio Results

# Double Ratio vs $p_T$



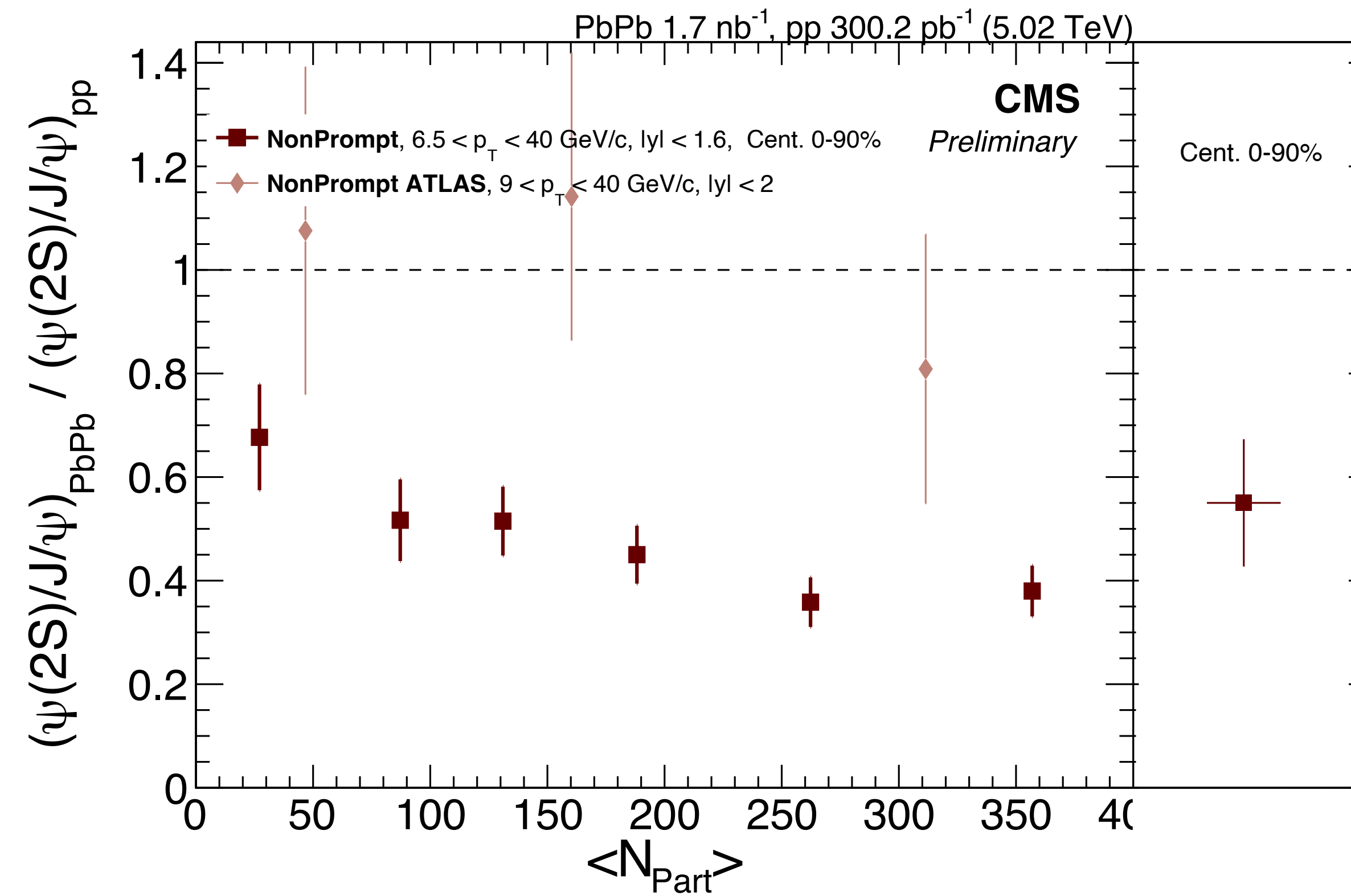
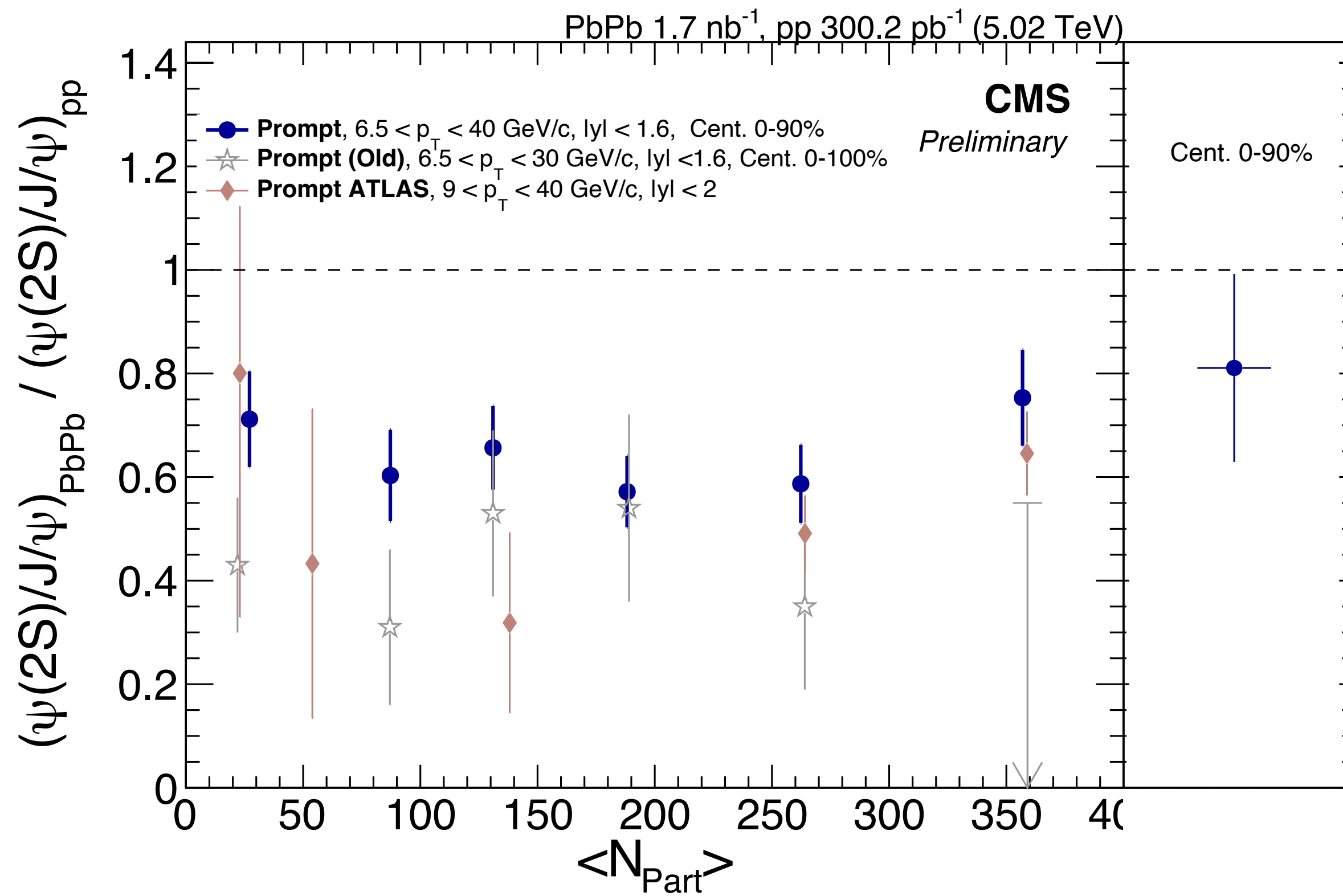
- The double ratio values are compatible with ALICE and previous results
- Values look flat or slightly increasing as increasing  $p_T$

# Double Ratio vs $p_T$



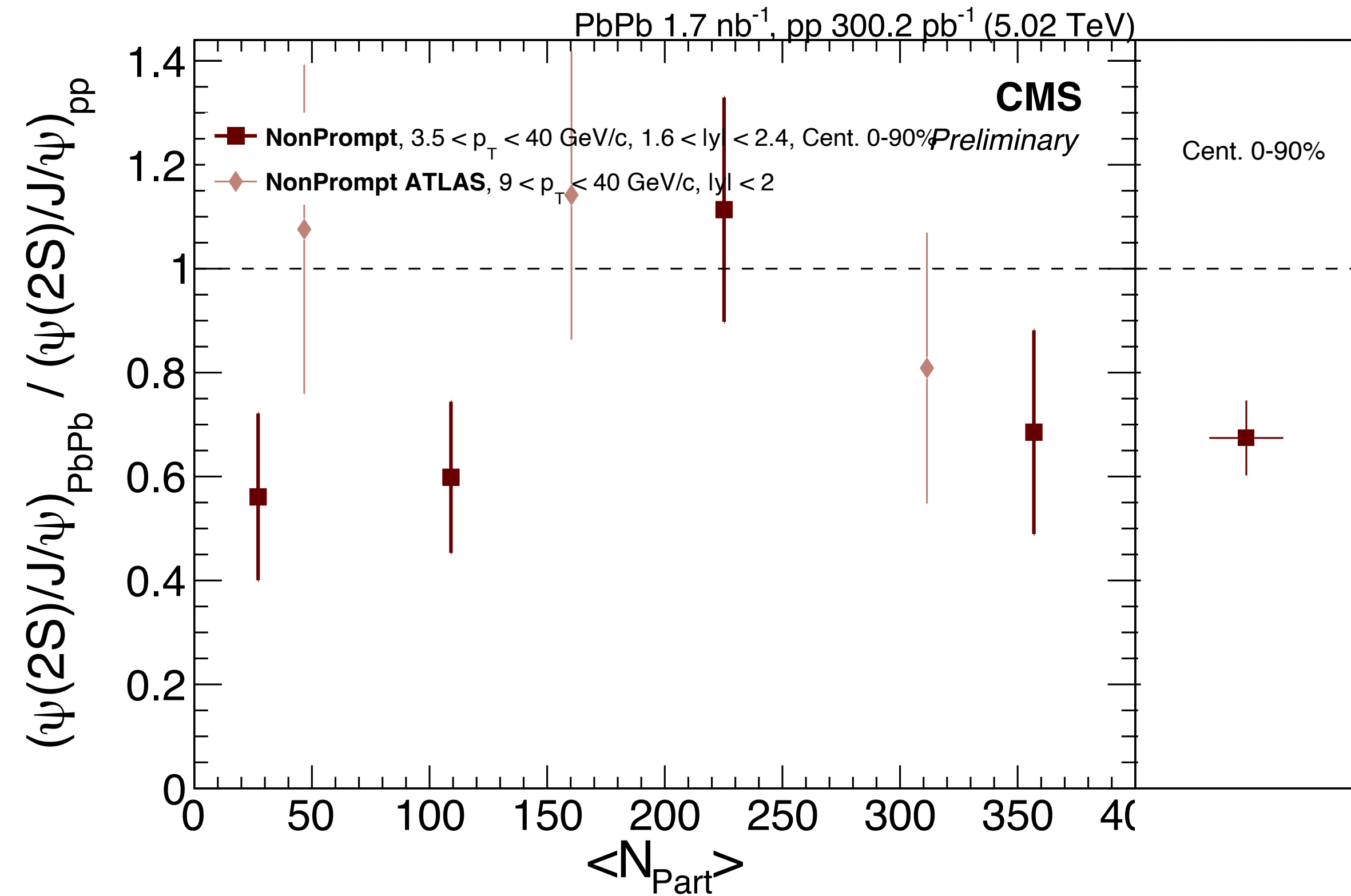
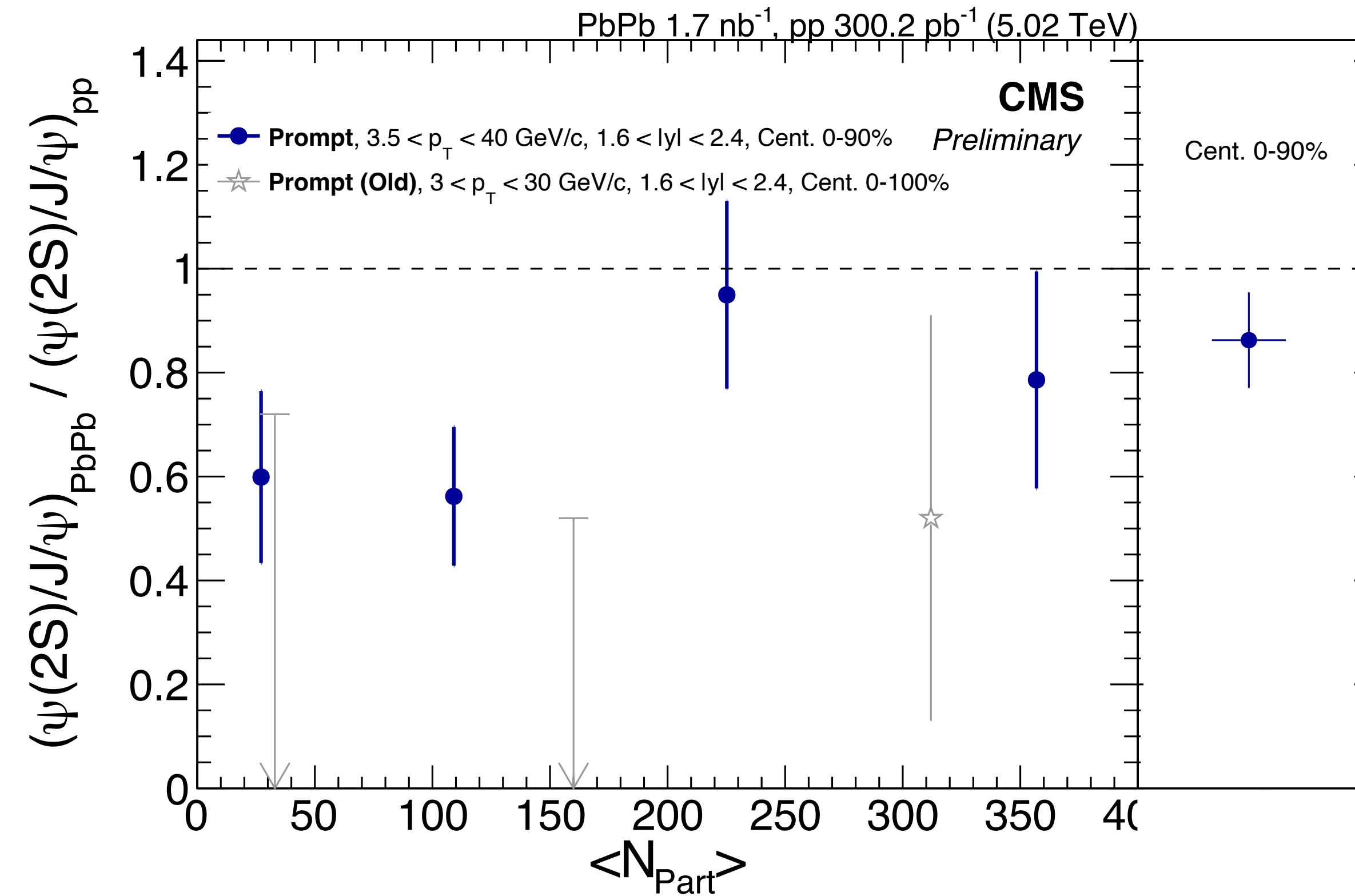
- Observed double ratio at  $3.5 < p_T < 6.5$  reaches to 1, which means that the  $\psi(2S)$  is not suppressed or indicates the regenerated

# Double Ratio vs $\langle N_{part} \rangle$



- Compatible with other results and observed same trend of ATLAS measurement but the result of nonprompt indicates there is tension each other

# Double Ratio vs $\langle N_{\text{part}} \rangle$



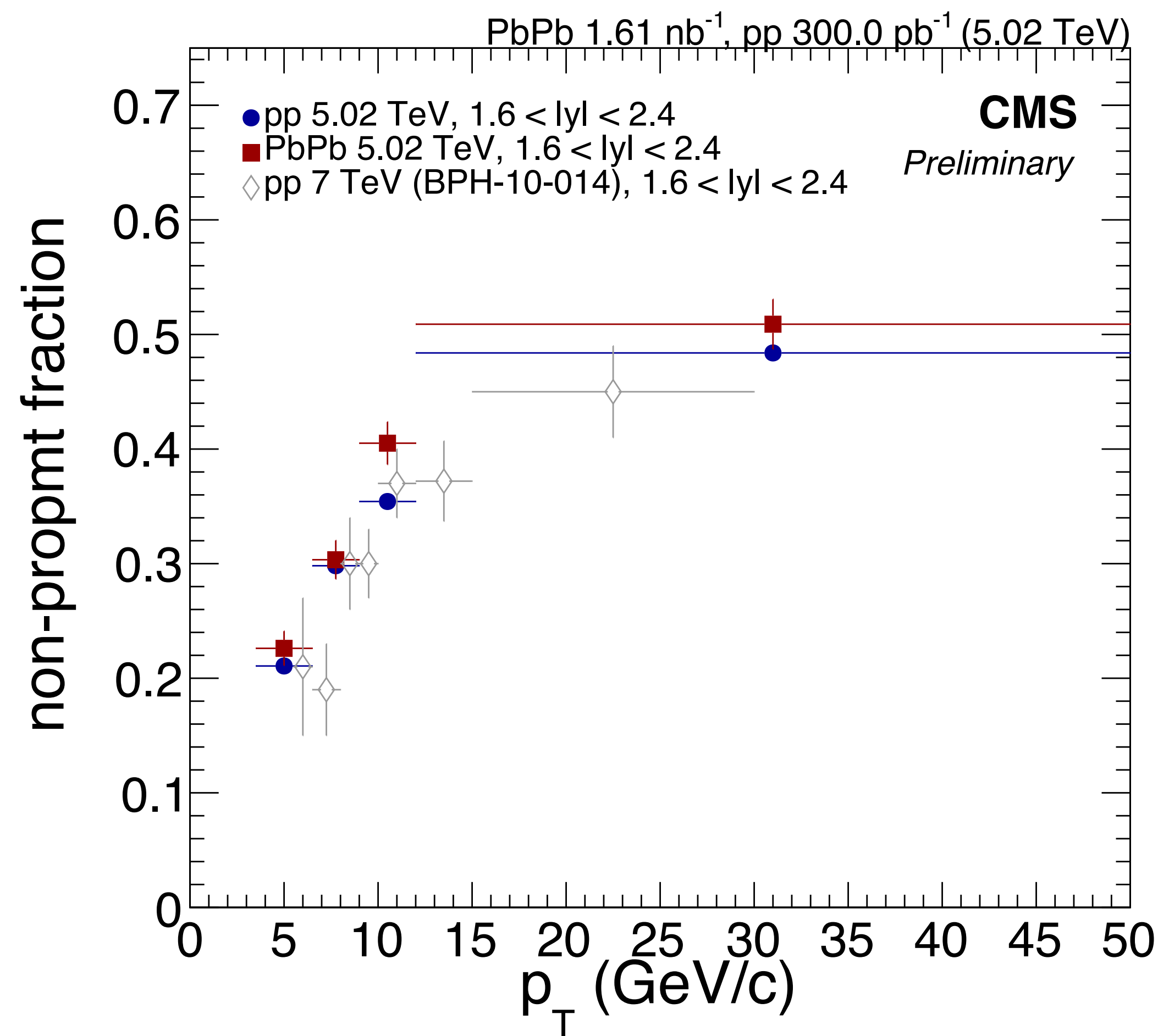
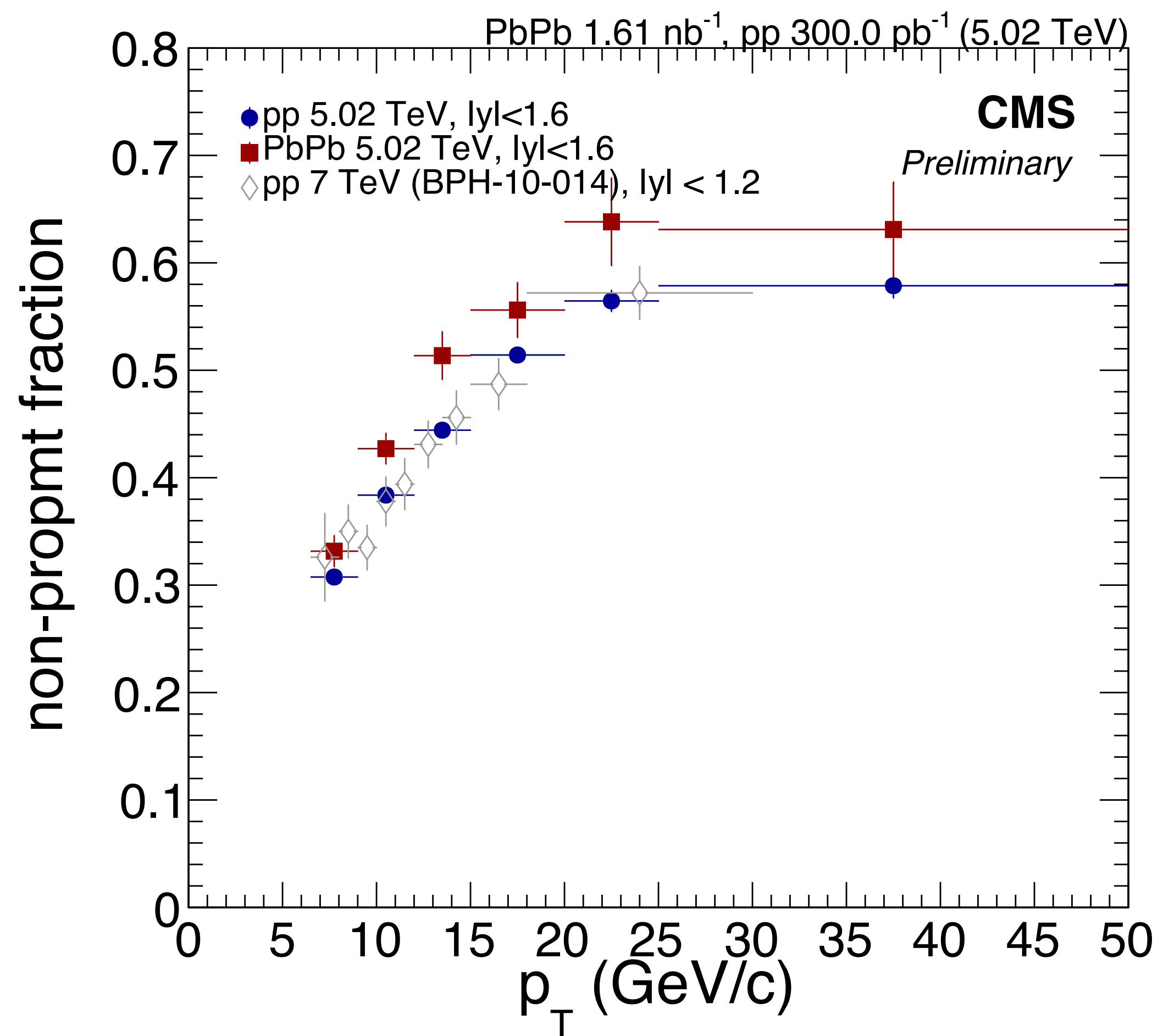
- At the forward region, the results are agreed with previous measurement and observed regeneration effect in more central events



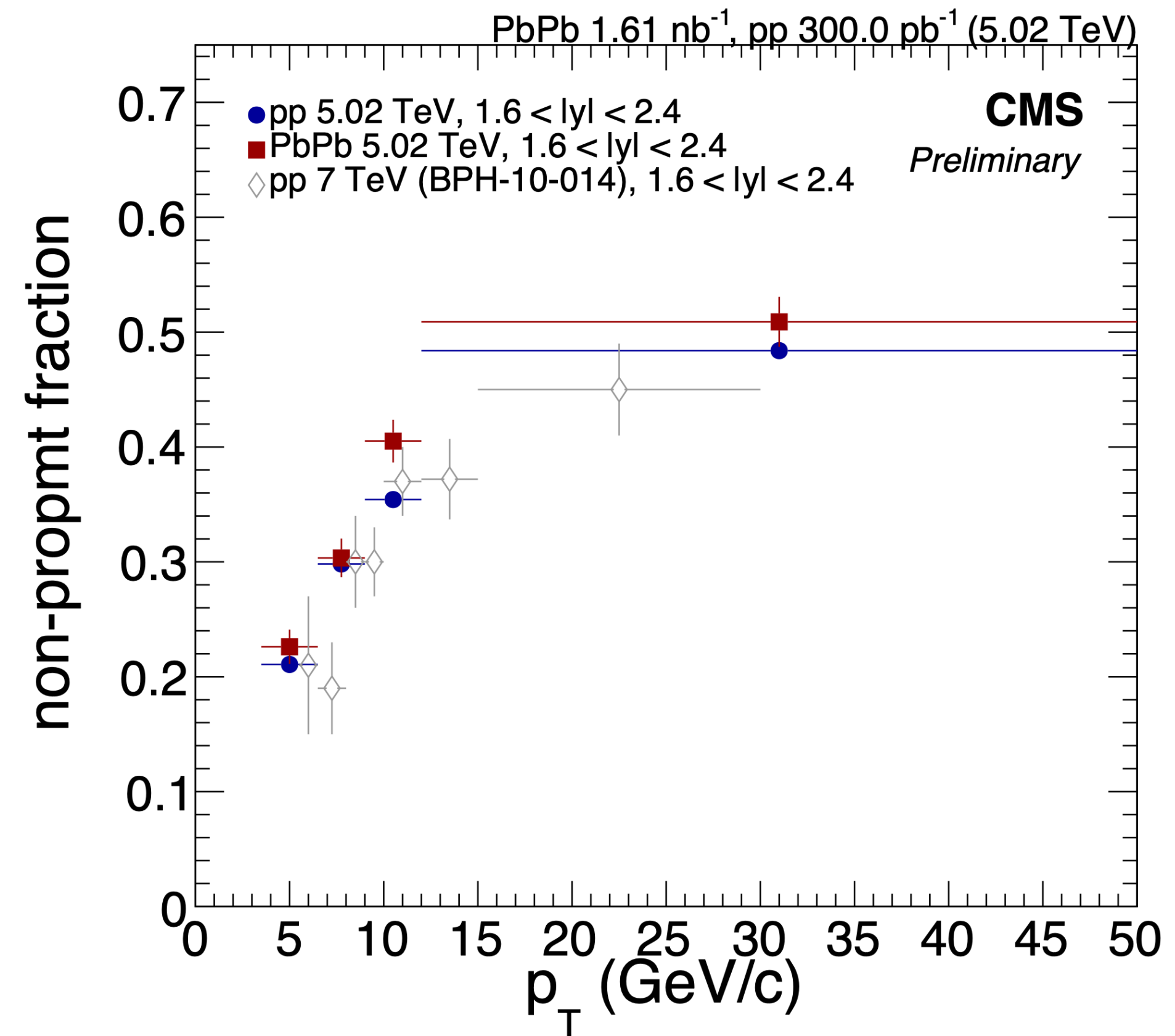
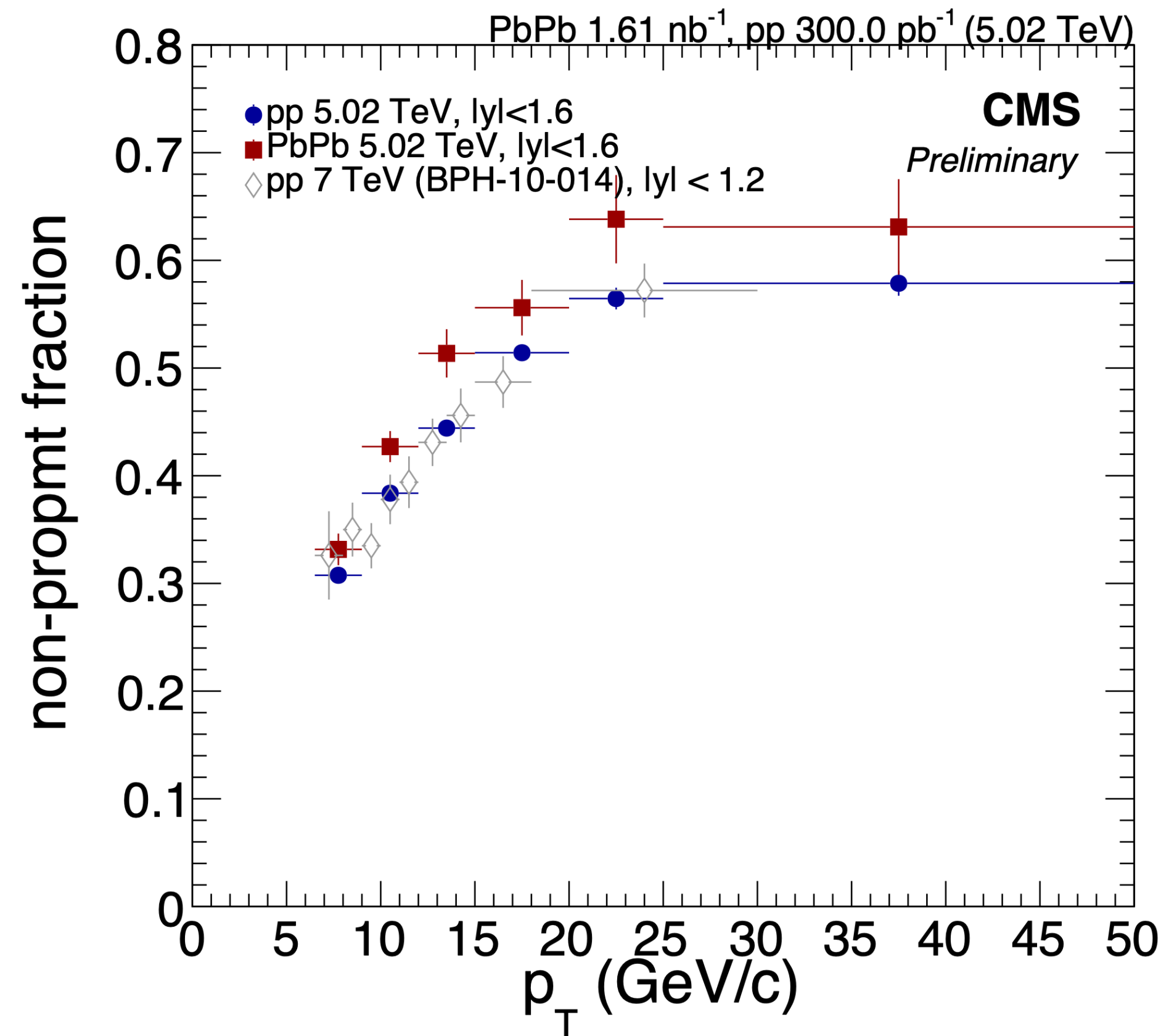
- Still trying to understand the meaning of our observation
- Ongoing to get systematic uncertainties for  $J/\psi$
- Keep studying with finer bins for  $J/\psi R_{AA}$  than HIN-16-025

# Backup

# Nonprompt fraction of $\psi(2S)$

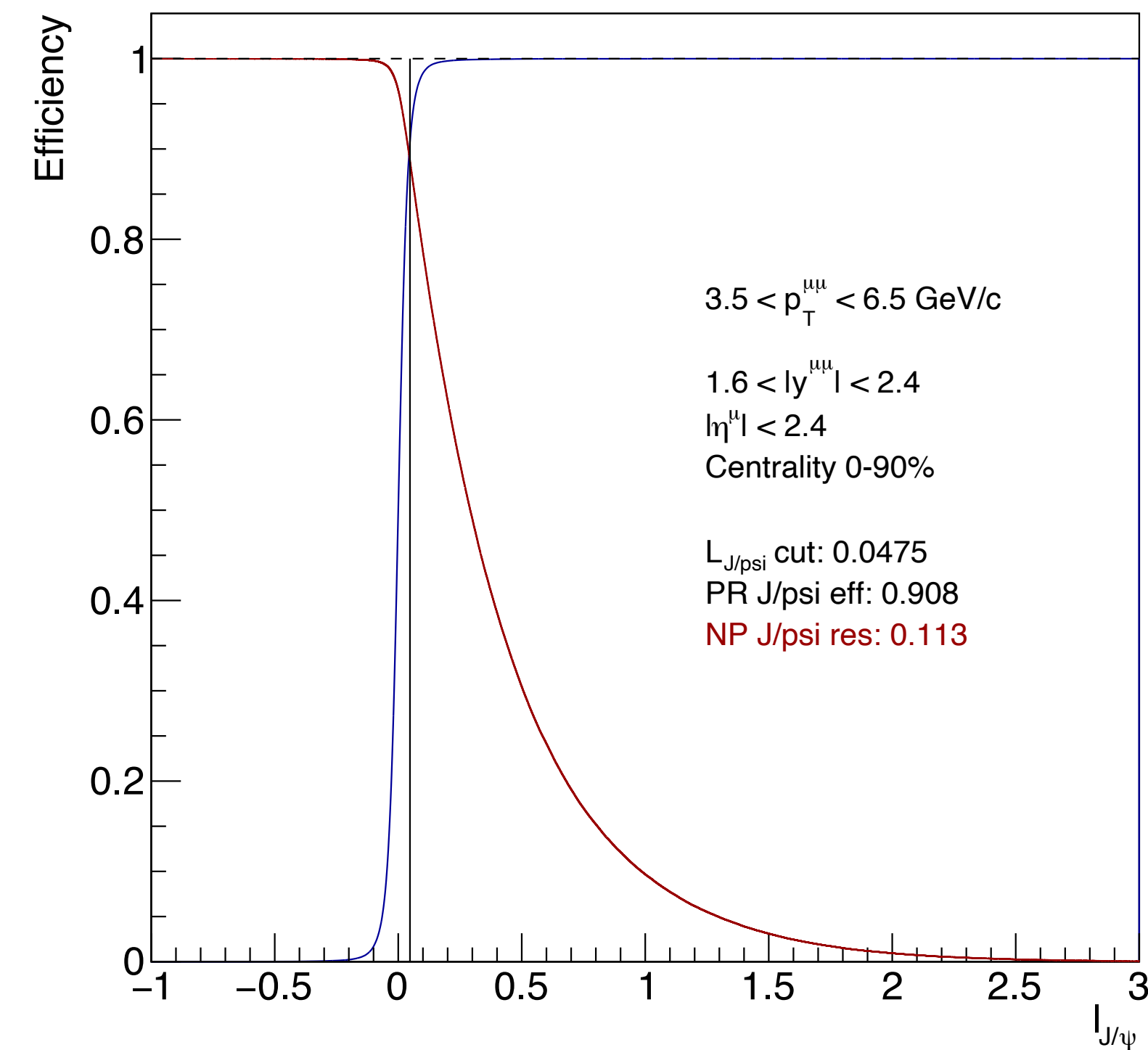
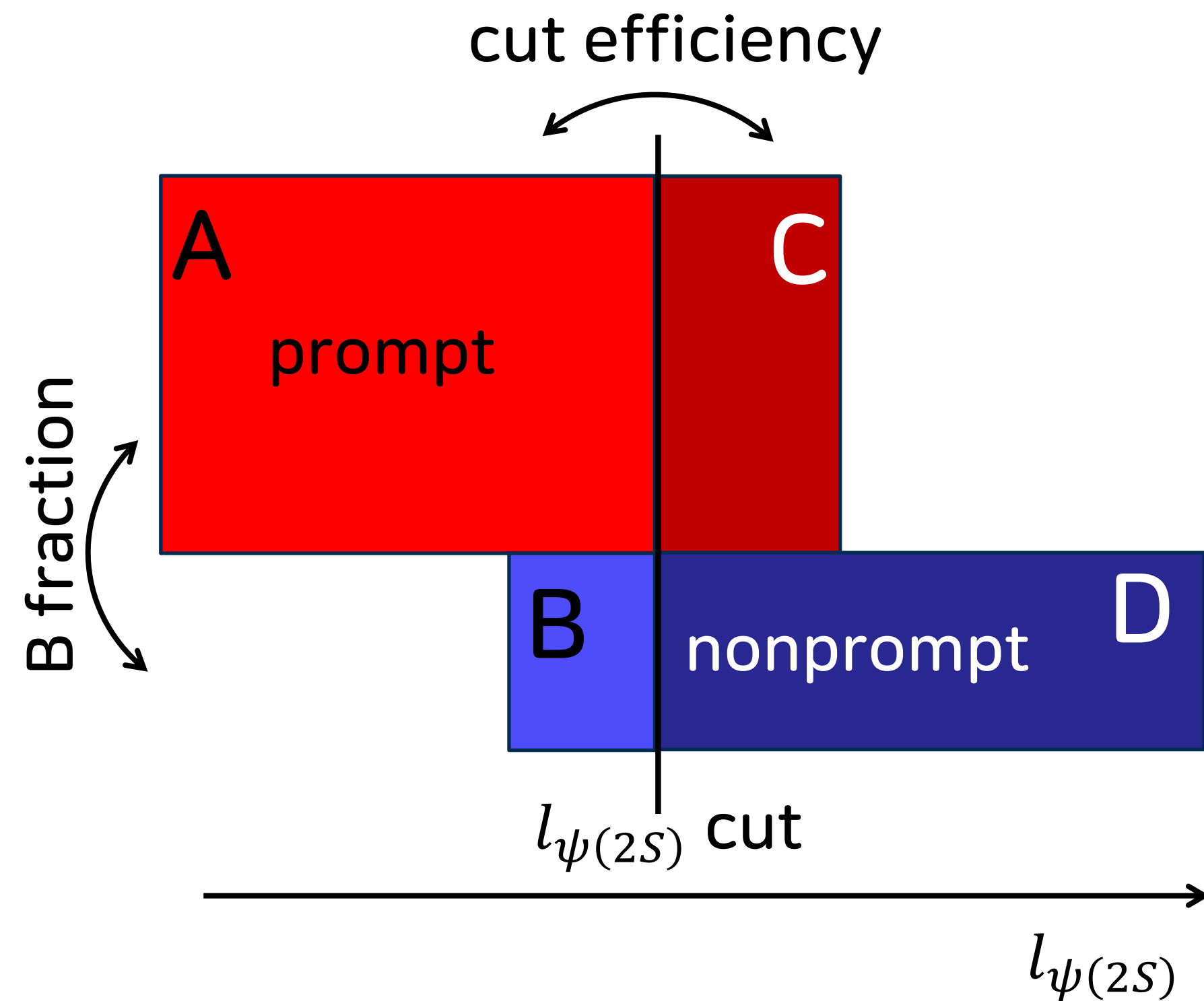


# Nonprompt fraction of $J/\psi$



- Compare with BPH-10-014 results

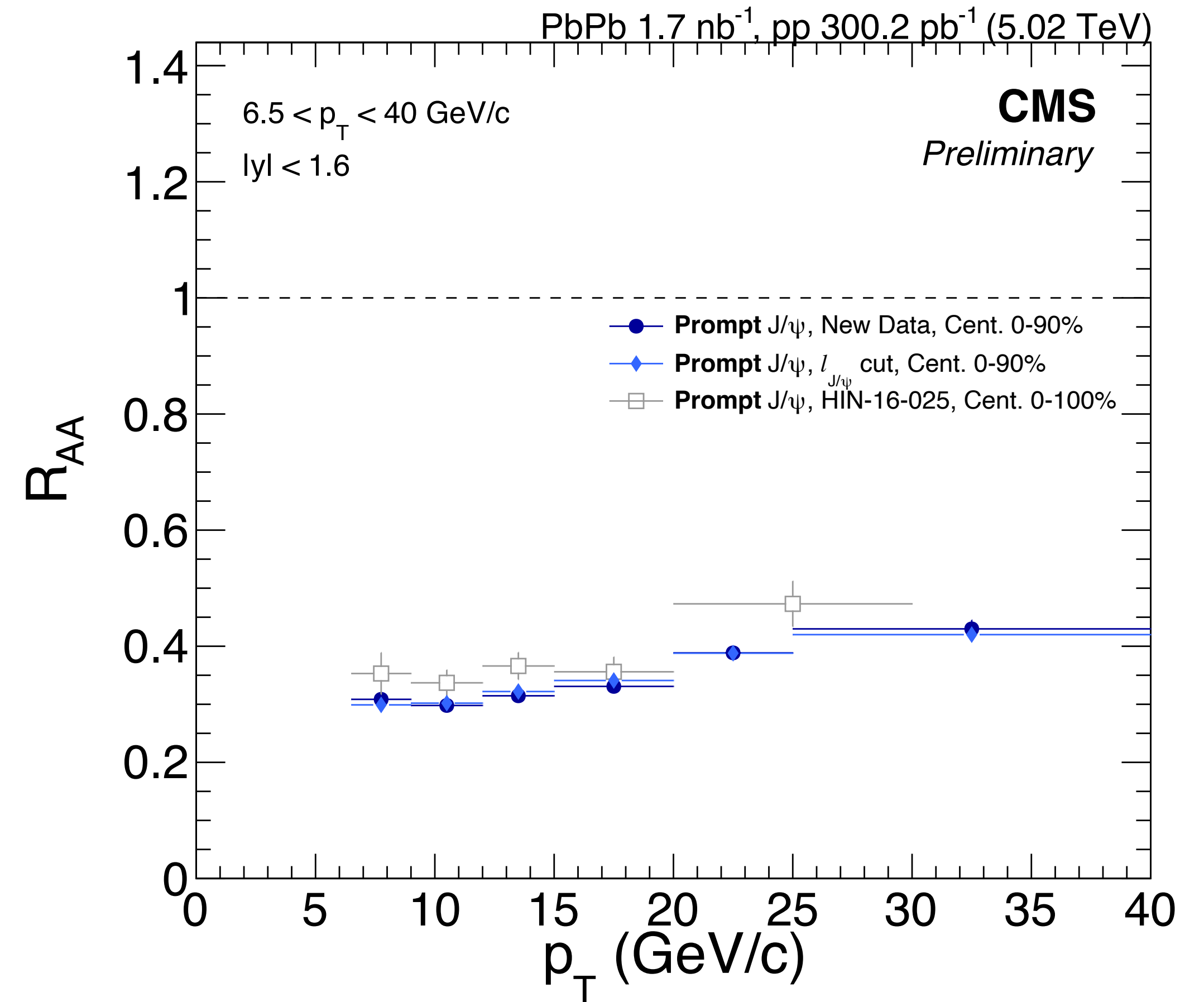
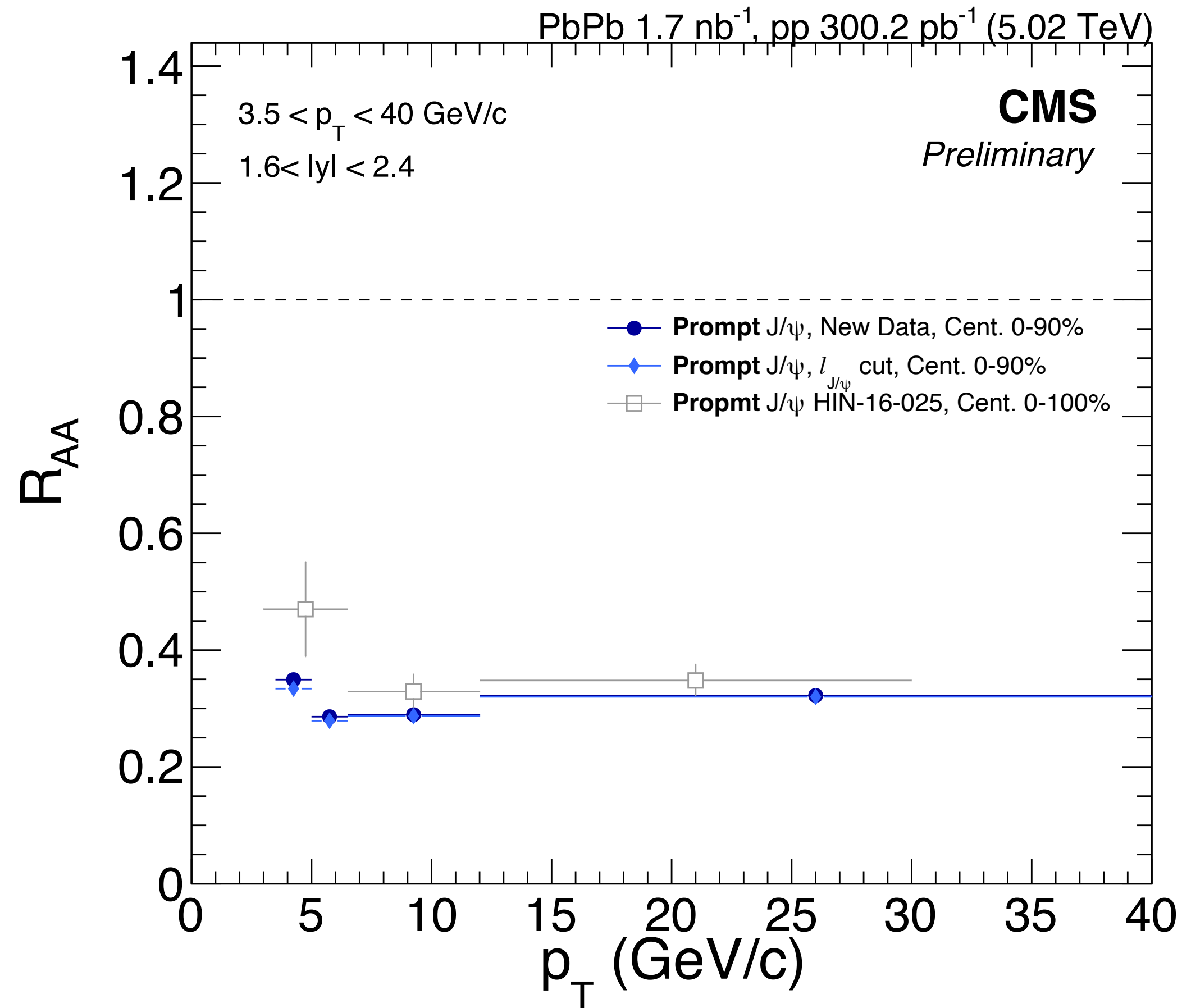
# Compare with $l_\psi$ efficiency cut results



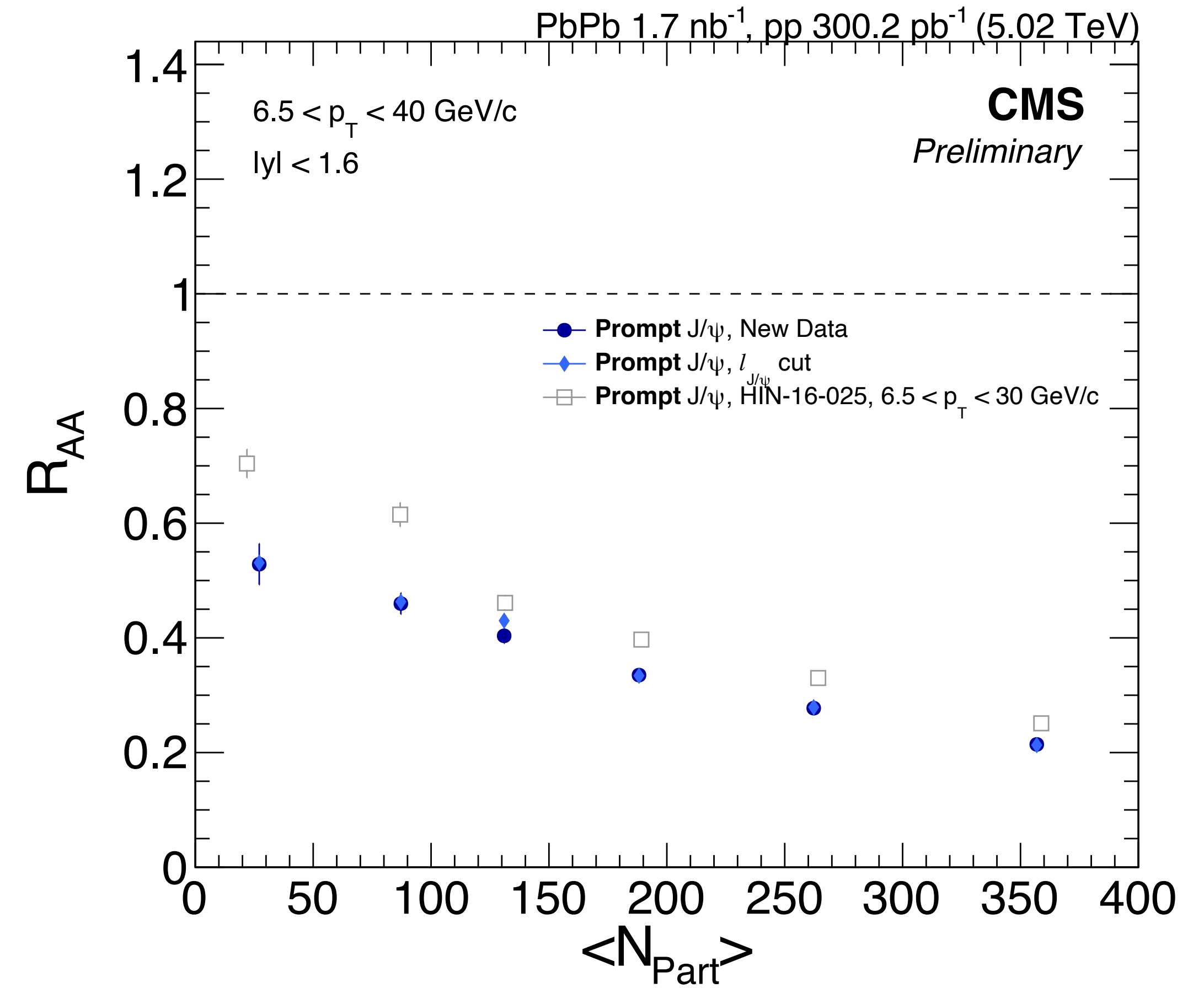
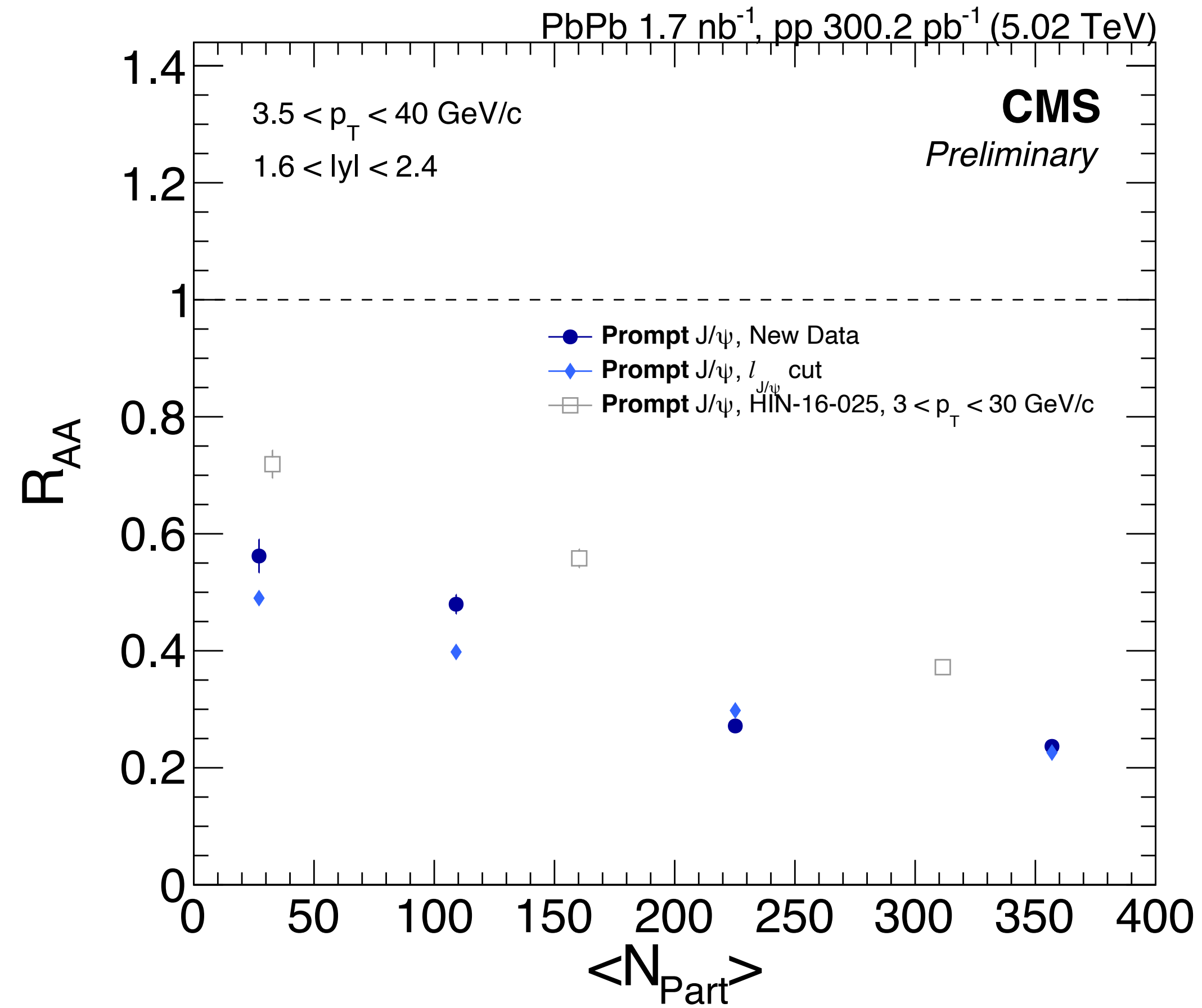
- $N_{pass} = f \cdot N_{total} \cdot \epsilon_{NP} + (1 - f) \cdot N_{total} \cdot \epsilon_{PR}$
- $f = \frac{N_{pass} - N_{total} \epsilon_{PR}}{N_{total} (\epsilon_{NP} - \epsilon_{PR})}$



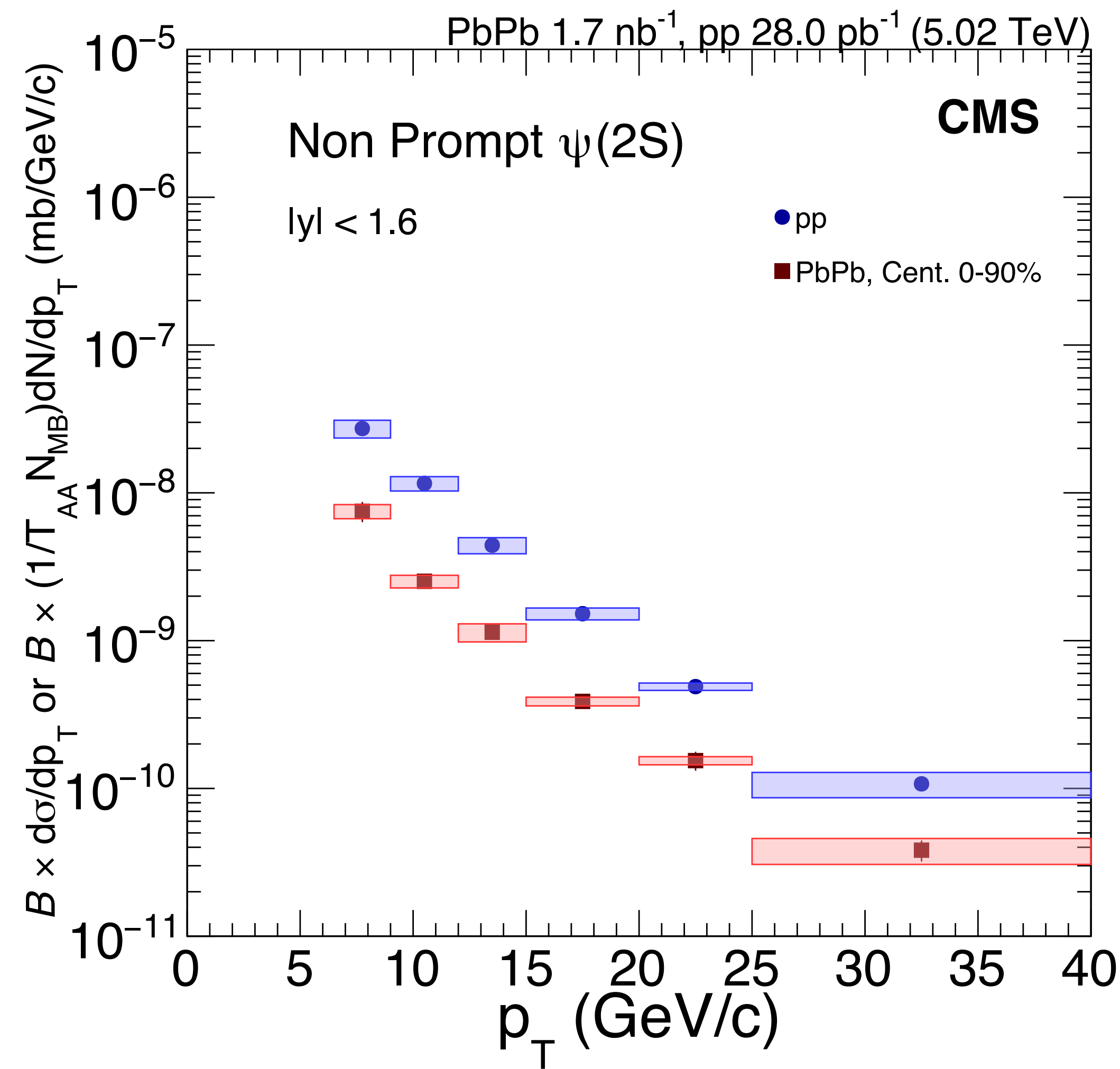
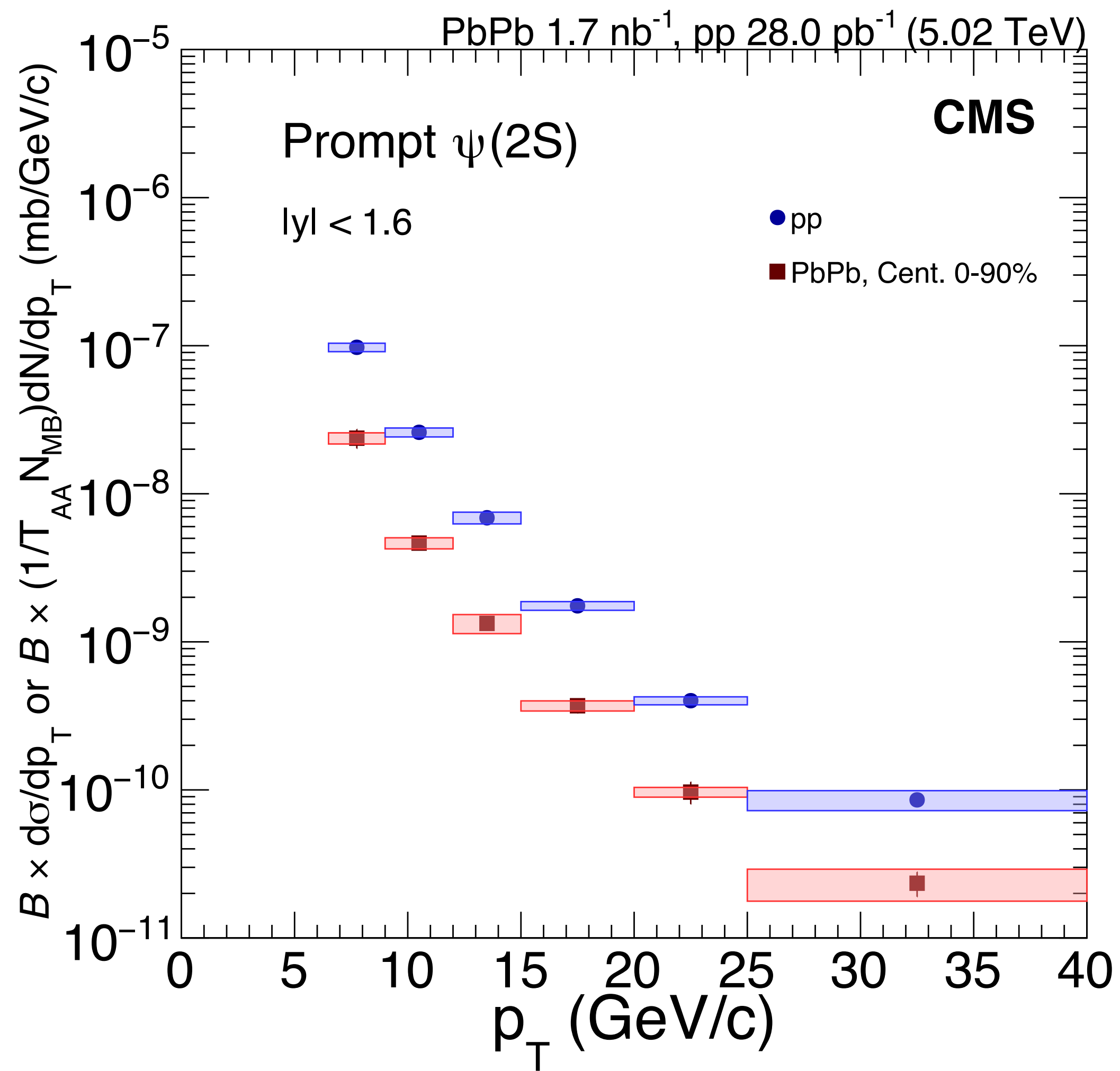
# Compare with $l_{J/\psi}$ efficiency cut results



# Compare with $l_{J/\psi}$ efficiency cut results



# Cross section



# Cross section

