Inclusive J/ψ production at mid-rapidity in Pb-Pb collisions at $\sqrt{s_{NN}}$ = 5.02 TeV with ALICE

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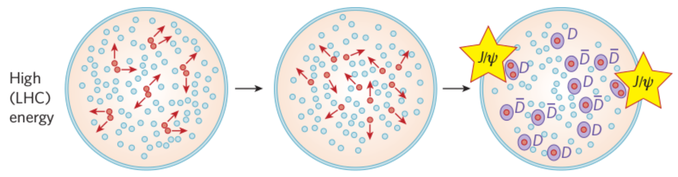
Motivation

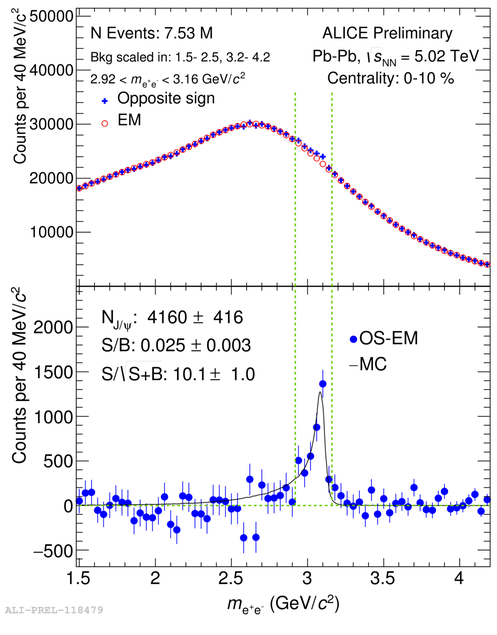
- J/ψ is considered as a key observable for deconfinement in heavy-ion collisions
- Initial idea: charmonium states are 'melted' in the hot and dense deconfined medium due to an effective screening of the binding force [1]
- New insight: at LHC energies J/ψ mesons might be produced by (re)combination of thermalized charm quarks throughout the evolution of the system or at the phase boundary [2, 3]



P. Braun-Munzinger, J. Stachel, Nature 448 (2007) 302

Analysis Details

- At mid-rapidity in ALICE J/ψ are reconstructed in the e^+e^- decay channel
- Electron selection:
  $p_T > 1.0$ GeV/c $\quad |\eta| < 0.8$
  dE/dx consistent with electron expectation
  primary track selection
- Rejection of electrons from photon conversions based on single track quantities and invariant mass
- The background is estimated by event mixing
- The raw yield is extracted by bin counting in the mass window

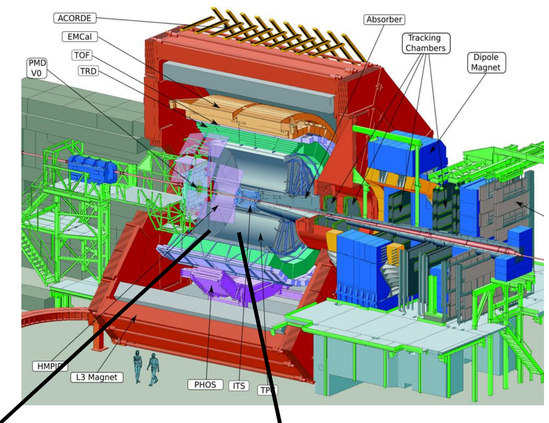


Corrected yield in interval i:

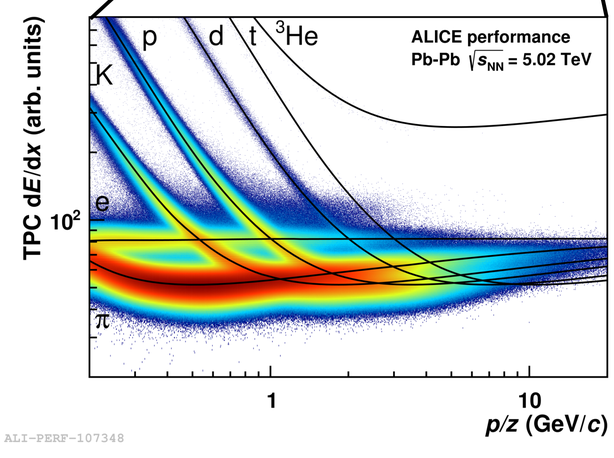
$$Y^i_{J/\psi} = \frac{N^i_{J/\psi}}{BR_{J/\psi \to e^+e^-} N^i_{events} A \times \epsilon^i}$$

Experimental Apparatus

- ALICE provides very good particle identification capabilities (PID) down to $p_T = 0$
- For this analysis the specific energy loss dE/dx in the Time Projection Chamber (TPC) is used for electron identification



TPC PID



Results

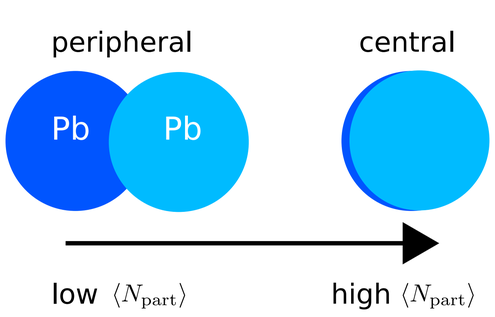
- The results are presented in terms of the nuclear modification factor:

$$R_{AA} = \frac{Y^{Pb\text{-}Pb}_{J/\psi}}{\langle T_{AA} \rangle \times \sigma^{pp}_{J/\psi}}$$, where:

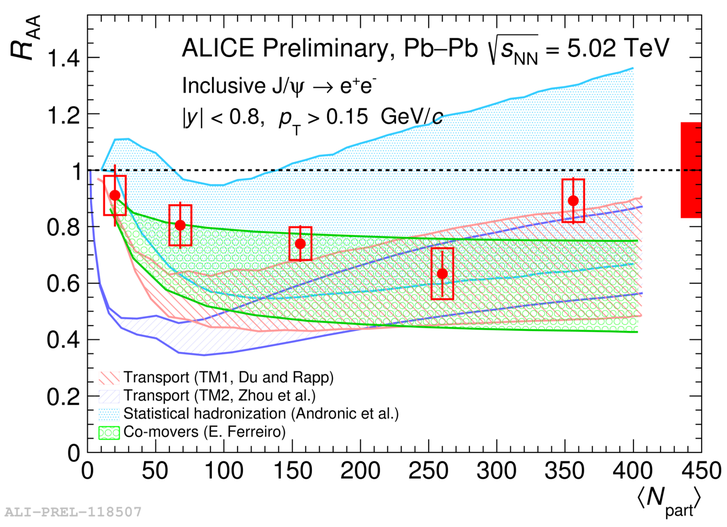
$\langle T_{AA} \rangle$ is the nuclear overlap function which is proportional to the number of binary nucleon-nucleon collisions,

$\sigma^{pp}_{J/\psi}$ is the J/ψ pp reference cross section at √s = 5.02 TeV which is obtained from an interpolation of measurements at different collision energies (√s = 0.2, 1.96, 2.76 and 7 TeV) [4, 5, 6, 7]

- The centrality of the collisions is expressed as the average number of nucleons participating in inelastic collisions $\langle N_{part} \rangle$



Centrality dependence



The data are consistent with models that assume J/ψ production by (re)combination of deconfined charm quarks

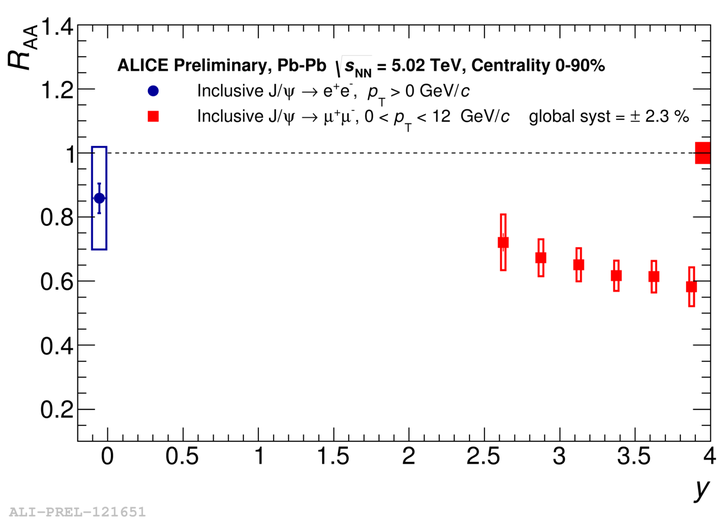
Transport models: continuous J/ψ production and destruction during the lifetime of the medium [8, 9, 10]

Statistical hadronization model: J/ψ production at the phase boundary from thermalized charm quarks [11]

Co-mover model: effective description of J/ψ destruction and (re)combination without assuming thermal equilibrium [12, 13]

Large theoretical uncertainties due to imprecise knowledge of charm cross section and shadowing

Rapidity dependence



Comparison of our mid-rapidity result with the results obtained at forward rapidity in the $\mu^+\mu^-$ channel

The data show a trend of enhanced J/ψ production towards mid-rapidity

In the picture of the (re)combination models this can be explained by a larger charm quark density towards mid-rapidity and thus, a higher (re)combination probability

The systematic uncertainty at mid-rapidity is dominated by the pp reference cross section

Outlook

- The measurement of the J/ψ p_T spectrum will provide further insights into the dynamics of (re)combination
- The separation of prompt and non-prompt J/ψ will give access to b quark energy loss
- The anticipated statistics for LHC Run 3 will enable multi-differential J/ψ measurements and also enable the measurement of other quarkonium states at mid-rapidity

References

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