J/ψ production in Pb-Pb collisions measured with ALICE*

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Heavy quarkonium production is a prime probe for the investigation of the deconfined nuclear medium created during ultra-relativistic nuclear collisions, also dubbed quark-gluon plasma. Early predictions assumed that, depending on their binding energy, some of the quarkonium states melt in such a hot and dense medium due to colour screening [1]. At the LHC energies, and to a smaller extent at the RHIC top energy, the large number of charm quark pairs produced in the initial partonic interactions open the possibility for creating charmonium by combining $c\bar{c}$ pairs during the lifetime of the fireball [2] or at its phase boundary (chemical freeze-out) [3].

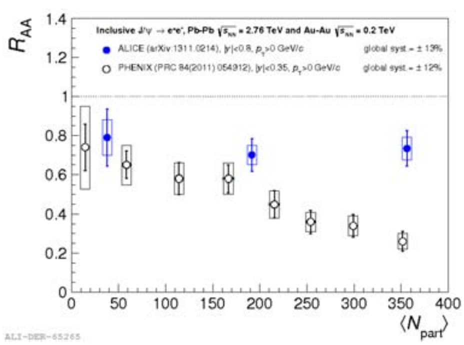

Figure 1: Centrality dependence of the R_{AA} for inclusive J/ψ measured by ALICE and PHENIX.

ALICE is a very well suited detector to measure J/ψ mesons via their di-leptonic decay channels [4] in a wide range of rapidity and down to zero transverse momentum. The nuclear effects on the J/ψ production are quantified using the nuclear modification factor, R_{AA}, which is the ratio between the yields obtained in nuclear collisions and the yield in pp collisions scaled by the number of binary nucleon-nucleon collisions corresponding to a given collision centrality.

Figure 1 shows the inclusive J/ψ R_{AA} at mid-rapidity as a function of the number of nucleons participating in the collision. The ALICE results [5] are obtained for Pb-Pb collisions at $\sqrt{s_{NN}} = 2.76$ TeV while the PHENIX [6] ones come from Au-Au collisions at $\sqrt{s_{NN}} = 0.2$ TeV. The lower energy data shows an increasing suppression of the J/ψ yield with increasing the collision centrality, being very suggestive of the colour screening effect predicted in [1]. The ALICE results indicate a much smaller suppression for larger system sizes and, within the uncertainties, no centrality dependence. The striking difference in R_{AA} in central collisions indicates that a new mechanism, namely charm quarks (re)combination, is at play at LHC energies.

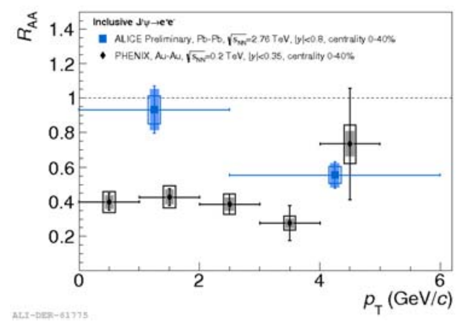

Figure 2: Transverse momentum dependence of the R_{AA} for inclusive J/ψ measured by ALICE and PHENIX.

In figure 2, we show the p_T dependence of the J/ψ R_{AA} for the 40% most central collisions from both ALICE and PHENIX. Our data is compatible with no suppression in the low p_T region ($p_T < 2.5$ GeV/c), opposite to the strong suppression seen at the RHIC top energy. At higher p_T, the J/ψ R_{AA} obtained by ALICE drops to ≈ 0.5 and is compatible with the one observed by PHENIX. If J/ψ mesons would be formed via the coalescence or statistical hadronisation of charm quarks, it is expected from phase space considerations that these mechanisms contribute especially in the low p_T region, as observed in our data.

These results, together with the ones obtained at forward rapidity in the di-muon channel [5], provide important evidence for deconfinement and for a new mechanism of charmonium creation. Further studies on understanding the cold nuclear matter effects using p-Pb collisions are currently ongoing [7].

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