Statistical hadronization of J/ψ in Au+Au collisions at $\sqrt{s_{NN}}$=200 GeV

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Since its proposal twenty years ago [1] as a crucial observable for the diagnosis of the Quark-Gluon Plasma (QGP) produced in ultra-relativistic nucleus-nucleus collisions, the J/ψ meson has been the focus of intense experimental and theoretical efforts. The original idea of J/ψ melting in QGP [1] was more recently challenged with the idea that J/ψ production takes place at the chemical freeze-out [2], which appears to be coincident with the hadronization transition.

We present a comparison of statistical hadronization model (SHM) predictions to the recent data from RHIC [3] concerning the centrality and rapidity dependence of J/ψ production. We investigate the yields relative to those expected from binary scaling of production in pp collisions [5], as quantified by the observable:

$$R_{AA}^{J/\psi} = \frac{\mathrm{d}N_{J/\psi}^{AuAu}/\mathrm{d}y}{N_{coll}\cdot \mathrm{d}N_{J/\psi}^{pp}/\mathrm{d}y} \qquad (1)$$

where $\mathrm{d}N_{J/\psi}/\mathrm{d}y$ is the rapidity density of J/ψ yield integrated over transverse momentum and N_{coll} is the number of binary collisions for a given centrality class. We have recently presented [4] a comprehensive summary of the statistical hadronization model for charmed hadrons, as well as of the influence of the input parameters on its results.

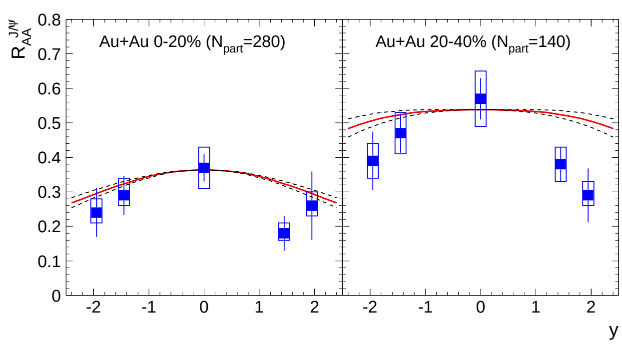

Figure 1: Rapidity dependence of $R_{AA}^{J/\psi}$ for two centrality classes. The data at RHIC are from PHENIX [3]. Besides the statistical and systematical errors (denoted by the bars and boxes), a global systematic error of the order of 10% for the data has to be additionally applied.

In Fig. 1 we present the rapidity dependence of $R_{AA}^{J/\psi}$. Our calculations reproduce the $R_{AA}^{J/\psi}$ data well. We note that a constant $R_{AA}^{J/\psi}$ value or with a minimum at midrapidity is expected within the melting model [1]. The maximum of $R_{AA}^{J/\psi}$ at midrapidity is in our model due to the enhanced regeneration yield, determined by the rapidity dependence of the charm cross section. In details, our model is in very good agrement with the data for the central bin (0-20%), while predicting for the mid-central (20-40%) centrality class a somewhat flatter shape than observed in the data. The error of the experimental J/ψ data in pp [5] used in our model plays a rather minor role, as denoted by the dashed lines in Fig. 1.

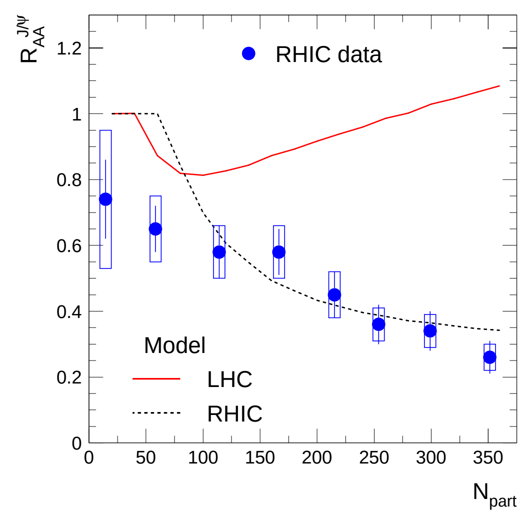

Figure 2: Centrality dependence of the $R_{AA}^{J/\psi}$ for RHIC and LHC energies.

The centrality dependence of $R_{AA}^{J/\psi}$ at midrapidity is shown in Fig. 2. Our calculations approach the value in pp collisions around N_{part}=50, which corresponds to an adopted minimal volume for the creation of QGP of 400 fm^3 [4]. The model reproduces very well the decreasing trend versus centrality seen in the RHIC data [3]. Note that in our model this suppression arises entirely as a consequence of the still small number of charm quarks ($\mathrm{d}N_{c\bar{c}}/\mathrm{d}y$=1.6). It is important to stress that at the LHC energy ($\sqrt{s_{NN}}$=5.5 TeV) the charm production cross section is about 10 times larger and, as a result, an opposite trend is predicted, see Fig. 2.

References

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