

Charmonium production in relativistic heavy ion collisions

T. Song, K.C. Han, and C.M. Ko

Using the two-component model that includes charmonium production from both initial nucleon-nucleon hard scattering and regeneration in the produced quark-gluon plasma, we have studied J/ψ production in heavy-ion collisions at the Super Proton Synchrotron (SPS), Relativistic Heavy Ion Collider (RHIC), and Large Hadron Collider (LHC) [1]. For the expansion dynamics of produced hot dense matter, we have used a schematic viscous hydrodynamic model [2] with the specific shear viscosity in the quark-gluon plasma and the hadronic matter taken, respectively, to be two and ten times the lower bound of $1/4\pi$ suggested by the anti-de Sitter/conformal field theory (AdS/CFT) correspondence. For the initial dissociation and the subsequent thermal decay of charmonia in the hot dense matter, we have used the screened Cornell potential to describe the properties of charmonia and the perturbative QCD to calculate their dissociation cross sections [3]. Including regeneration of charmonia in the quark-gluon plasma via a

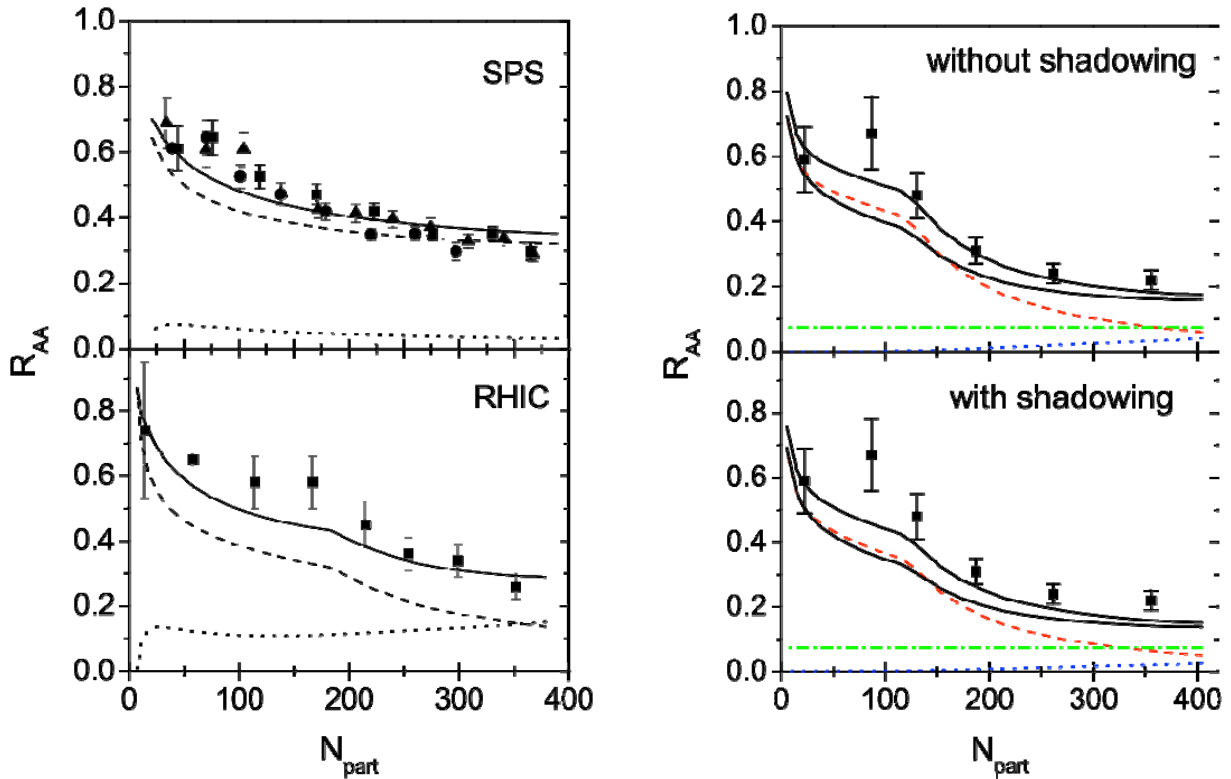


FIG. 1. Left window: Nuclear modification factor R_{AA} of J/ψ (solid line) as a function of the participant number N_{part} in Pb + Pb collisions at $\sqrt{s_{NN}} = 17.3$ GeV at SPS (upper panel) and in Au + Au collisions at $\sqrt{s_{NN}} = 200$ GeV at RHIC (lower panel). Dashed and dotted lines represent, respectively, the contributions to J/ψ production from primordial hard nucleon-nucleon scattering and regeneration in the QGP. Experimental data are from Refs. [4,5]. Right window: Same as left window for J/ψ of transverse momentum larger than 6.5 GeV/c without (upper panel) and with (lower panel) the shadowing effect in Pb + Pb collisions at $\sqrt{s_{NN}} = 2.76$ TeV at LHC. Dot-dashed line represents the contributions to J/ψ production from decay of bottom hadrons. Upper and lower solid lines are the total R_{AA} obtained with the nuclear absorption cross section of 0 and 2.8 mb, respectively. Experimental data shown by solid squares are from the CMS Collaboration [6].

kinetic equation with in-medium charmonium decay widths, we have obtained a good description of measured J/ψ nuclear modification factors in Pb + Pb collisions at $\sqrt{s_{NN}} = 1.73$ GeV at SPS and in Au + Au collisions at $\sqrt{s_{NN}} = 200$ GeV at RHIC as shown in the left window of Fig.1. A reasonable description of the measured nuclear modification factor of high transverse momenta J/ψ in Pb + Pb collisions at $\sqrt{s_{NN}} = 2.76$ TeV at LHC is also obtained as shown in the right window of Fig.1.

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