Charmonium production and elliptic flow in relativistic heavy ion collisions

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We have studied the nuclear modification factor R_{AA} and elliptic flow v_2 of J/ψ in relativistic heavy ion collisions [1] in a two-component model [2] that includes contributions from both initial hard nucleon-nucleon scattering and regeneration in the quark-gluon plasma. For the expansion dynamics of produced hot, dense matter, we have introduced a schematic fireball model with its transverse acceleration determined from the pressure gradient inside the fireball and azimuthally anisotropic expansion parameterized to reproduce measured v_2 of light hadrons. We have assumed that light hadrons freeze out at the temperature of 120 MeV while charmonia free out at 160 MeV, similar to the kinetic and chemical freeze-out temperatures in the statistical model, respectively. For the properties of charmonia in the quark-gluon plasma, we have used the screening mass between their charm and anticharm quarks and their dissociation cross sections given by the perturbative QCD (pQCD) calculations in the leading order and up to the next-to-leading order, respectively [3]. For the relaxation time of charm and anticharm quarks in the quark-gluon plasma, we have also used the one calculated in the leading-order pQCD [2]. Modeling the effect of higher-order corrections in pQCD by introducing multiplicative factors to the dissociation cross section of charmonia and the elastic scattering cross section of charm and anticharm quarks, we have found that this effect is small for the R_{AA} of J/ψ as they suppress the number of initially produced J/ψ but enhance the number of regenerated ones as shown in the left window of Fig. 1. The higher-order corrections increase, however, the v_2 of J/ψ as shown in the

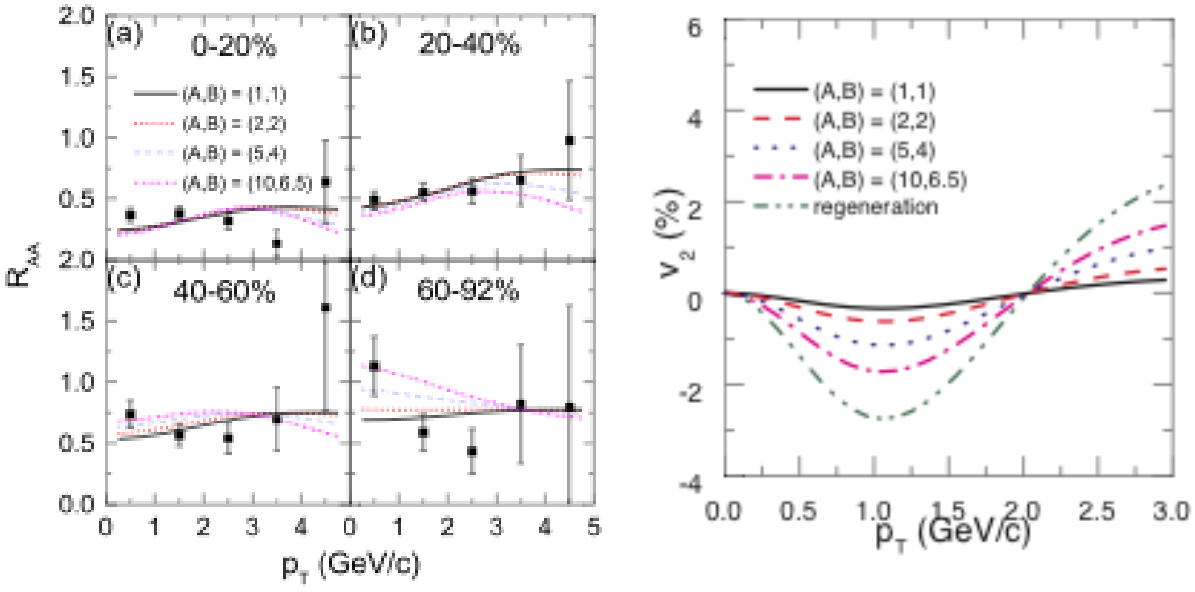

FIG. 1. Charmonium nuclear modification factor R_{AA} in collisions of 0-20% (a), 20-40% (b), 40-60% (c) and 60-92% (d) centralities (left window) and elliptic flow v_2 (right window) as functions of transverse momentum for different multiplicative factors (A,B) = (1,1), (2,2), (5,4) and (10,6.5) to the J/ψ dissociation and charm quark scattering cross sections.

right window of Fig. 1. Our results suggest that the v_2 of J/ψ can play an important role in discriminating between J/ψ production from initial hard collisions and from regeneration in the quark-gluon plasma.

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