Heavy quark energy loss in PbPb collisions at $\sqrt{s_{NN}}$ = 2.76 TeV

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Introduction

The heavy quarks are produced in hard partonic interactions in heavy ion collisions and their initial momentum distribution can be calculated from pQCD. While traversing the hot/dense medium formed in the collisions, heavy quarks loose energy either due to the elastic collisions with the plasma constituents or by radiating a gluon or both. There are several formulations to calculate the collisional as well as the radiative energy loss which are used to calculate the nuclear modification factor R_{AA}. The R_{AA} contains other effects such as nuclear shadowing which must be taken into account in addition to energy loss. R_{AA} including shadowing and energy loss is evaluated for B and D and are compared with the measurements in PbPb collision at $\sqrt{s_{NN}}$ = 2.76 TeV.

Energy loss formalism and evolution model

In this paper, we calculate the radiative energy loss of heavy quark using reactor operator formalism [1] and generalised dead cone approach present [2, 3]. We calculate the collisional energy loss using Bjorken [4] and PP formalism [5]. The temperature of the QGP medium and the path length travelled by heavy quark in the plasma are evaluated using the evolution model which is described in Ref.[2, 6]. For the fragmentation of heavy quarks into mesons, Peterson fragmentation function is used.

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Results and discussions

Figure 1 shows the R_{AA} of D^0 mesons as a function of transverse momentum p_T using radiative energy loss (DGLV + Present) and shadowing in PbPb collision at $\sqrt{s_{NN}}$ = 2.76 TeV. We observe that radiative energy loss describes the ALICE measurements of D^0 mesons [7]. Figure 2 shows the R_{AA} of D^0 mesons as a function of number of participants $N_{\rm part}$ using radiative energy loss (DGLV and Present) and shadowing in PbPb collision at $\sqrt{s_{NN}}$ = 2.76 TeV. We observe that radiative energy loss describe the ALICE measurements of D^0 mesons [7].

Figure 3 shows the R_{AA} of inclusive J/ψ coming from B mesons as a function of transverse momentum p_T using energy loss (PP+DGLV, PP+Present and Bjorken+Present) and shadowing in PbPb collision at $\sqrt{s_{NN}}$ = 2.76 TeV. We observe that the sum of radiative energy loss (Present) and collisional energy loss (PP and Bjorken) over estimates the B meson suppression. The sum of radiative energy loss (DGLV) and collisional energy loss (PP) underestimates the B meson suppression. The data is CMS measurements of J/ψ from B decays [8]. Figure 4 shows the R_{AA} of inclusive J/ψ coming from B mesons as a function of number of participant $N_{\rm part}$ using energy loss (PP+DGLV, PP+Present and Bjorken+Present) and shadowing in PbPb collision at $\sqrt{s_{NN}}$ = 2.76 TeV. The data is CMS measurements of J/ψ from B decays [8]. We observe that the sum of radiative energy loss (DGLV) and collisional energy loss (PP) describes the CMS data very well. The sum of radiative energy loss (Present) and collisional energy loss (PP and Bjorken) over estimates the B meson suppression.

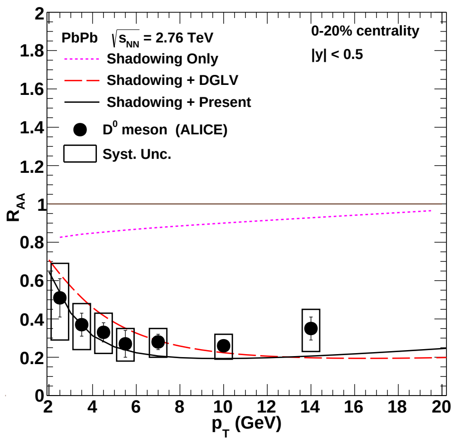

FIG. 1: R_{AA} of D^0 meson as a function of p_T.

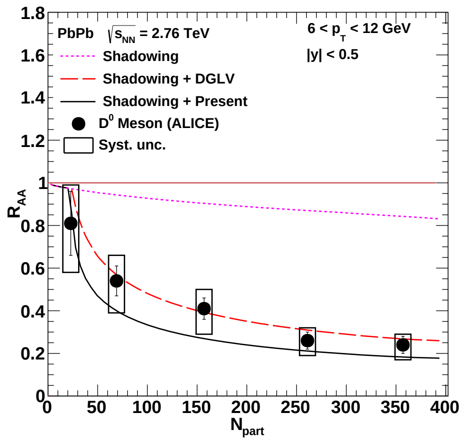

FIG. 2: R_{AA} of D^0 meson as a function of $N_{\rm part}$

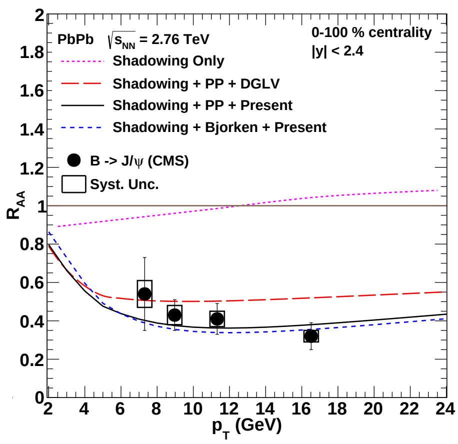

FIG. 3: R_{AA} of B meson as a function of p_T.

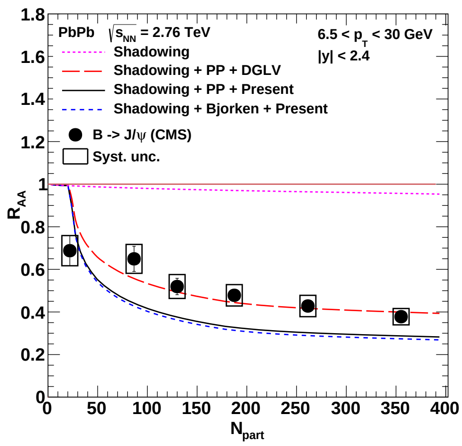

FIG. 4: R_{AA} of B meson as a function of $N_{\rm part}$

Conclusion

We find that the radiative energy loss from DGLV and Present calculation describes the D^0 mesons without requiring collisional energy loss. Both collisional as well as radiative energy loss are required to explain the B meson suppression.

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