# Nuclear suppression of single electrons at relativistic heavy ion collisions

Umme Jamil[§],[*] Raktim Abir[†], Munshi G. Mustafa[†], and Dinesh K. Srivastava[‡]
[§]*Department of Physics, Debraj Roy College, Golaghat, Assam 785 621, India*
[†]*Saha Institute of Nuclear Physics, Kolkata 700 064, India*
[‡]*Variable Energy Cyclotron Centre, Kolkata 700 064, India*

## Introduction

Heavy quarks produced from the initial fusion of gluons or light quarks propagate through the Quark-Gluon Plasma and lose energy in the process of scattering with the quarks and gluons and also by radiation of gluons. After their production, they may get fragmented into heavy mesons by picking up light quarks/antiquarks and in turn may decay through leptonic channels. These leptons would carry the information of the initial stage of heavy ion collisions and also the evolution of the plasma.

## Heavy quarks production in pp collisions

The differential cross section for heavy quark production is calculated considering the fusion of gluons ($gg \rightarrow Q\overline{Q}$) or light quarks ($q\overline{q} \rightarrow Q\overline{Q}$), in pp collisions at LO [1]. Our LO results are compared with the results obtained using NLO-MNR treatment developed by Mangano et al. [2]. Here we find a K factor ($\approx 2.5$) such that K times our LO results reproduce well the NLO-MNR result [3].

## Initial conditions and energy loss formalisms

All the calculations are done considering the central collsions of heavy nuclei and at midrapidity. The intrinsic transverse momentum of the heavy quarks are considered to be zero. The nuclear shadowing effect is introduced by EKS 98 parameterization [4] for nucleon structure functions. The central particle rapidity density is taken as $\approx 1100$ for Au+Au collisions at 200 AGeV and $\approx 2850$ for Pb+Pb collisions at 2.76 ATeV. The nuclear overlap function is calculated using Glauber model. We consider a situation, where, a heavy quark produced in a central collision, at the point (r, $\Phi$), and moves at an angle $\phi$ with respect to $\hat{r}$ in the transverse plane. The average distance, $\langle L \rangle$, traversed by the heavy quark is 5.78 fm for Au+Au collisions and 6.14 fm for Pb+Pb collisions. The initial time of formation of QGP, $\tau_0$ is taken as 0.2 fm/c. We approximate the expanding and cooling plasma with one at a temperature of T at $\tau = \langle L \rangle_{\rm eff}/2$, where $\langle L \rangle_{\rm eff} = \min\,[\langle L \rangle,\, v_T \times \tau_c]$, where $v_T$ is the transverse velocity of the heavy quark and $\tau_c$ is the critical temperature [3].

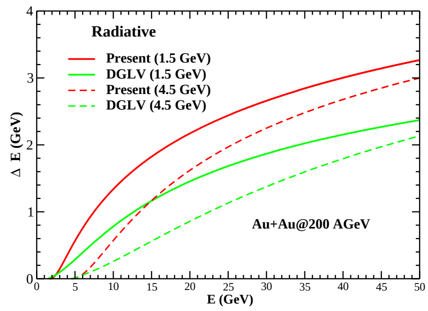


FIG. 1: Radiative energy loss suffered by charm and bottom quarks while passing through the QGP.

We consider the formalism developed by Peigne and Peshier (PP) to calculate the collisional energy loss and of Djordjevic, Gyulassy, Levai, and Vitev (DGLV) to calculate

*Electronic address: ummejamil@gmail.com

the radiative energy loss. We have also considered a recent formalism, which we will refer as 'Present', (see ref. [5]) to calculate radiative energy loss. In the 'Present' formalism we have obtained radiative energy loss in a canonical way using the most generalized form of gluon emission off a heavy quark [6].

In Fig. 1, we plot the transverse energy loss of charm and bottom quarks by radiative processes as a function of transverse energy at 200 ATeV at RHIC. The energy loss predicted by 'Present' formalism gives much higher energy loss compared to the prediction by DGLV formalism. The consequences of these difference in energy loss will be seen while discussing the $R_{AA}$ of single electron.

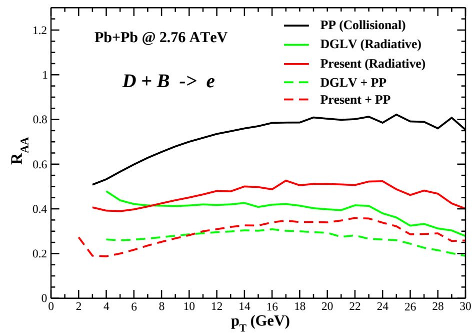


FIG. 3: Same as Fig. 2 in Pb+Pb collision at 2.76 ATeV.

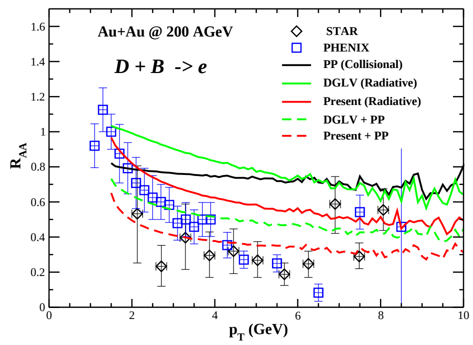


FIG. 2: $R_{AA}$ of single electron coming from D and B mesons in Au+Au collision at 200 AGeV, considering both the nuclear shadowing effect as well as the energy loss.

## $R_{AA}$ of single electrons

Our results of single electron $R_{AA}$ for Au+Au collisions at 200 AGeV are discussed in Fig. 2. The result obtained using only 'Present' radiative energy loss is found to agree well with the experimental data upto $p_T$ = 4 GeV [7, 8]. Where as inclusion of collisional energy loss alongwith the 'Present' formalism predicts more suppression. But the situation is different when we consider the DGLV formalism. DGLV formalism can explain the data upto $p_T = 4$ GeV only when the collisional energy loss is taken into account.

In Fig. 3, we give prediction for the single electron $R_{AA}$ for Pb+Pb collisions at 2.76 ATeV. The data [9] of D-mesons $R_{AA}$ for Pb+Pb collisions at 2.76 ATeV shows an increasing trend towards higher $p_T$. So, from the prediction of single electron $R_{AA}$, one can expect that 'Present' formalism would be able to explain the data at higher $p_T$.

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