A model study of D-meson production at LHC energies *

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Introduction

Heavy quarks produce much before the formation of de-confined state of matter and remain free to probe the thermalized medium. By quantifying their effect in small systems like p+p or p+Pb we can address some important effects, such as cold nuclear effect, nuclear shadowing and hadrnonisation mechanism. In this paper, we present analytical and model calculations of D-mesons (D^0, D^+ and D^{*+}) and comparison with published ALICE results in p+p collisions at $\sqrt{s}$ = 7 TeV and p+Pb collisions at $\sqrt{s_{NN}}$ = 5.02 TeV. Models such as HIJING and AMPT and anlytical calculations from NLO(MNR) and FONLL have been used for this study. HIJING model prediction matches with published p+p cross-section, AMPT calculation matches cross-section in p+Pb. We tried to explain the R_{pPb} data using NLO-pQCD(MNR), FONLL and other above mentioned models.

Analysis Technique

HIJING [2] (version 1.41) formulation is guided by Lund FRITIOF and Dual Parton Model at intermediate energy ($\sqrt{s} \leq 20GeV$). Eikonal formalism is used to calculate number of minijets per inelastic p+p collision which is further used to reproduce p+A or A+A results. Three parameter Woods-Saxon nuclear density is used in this model. Duke-Owens parton structure function (set 1) and mass dependence shadowing is used in this model.

AMPT [3] (version 26t5) used HIJING distribution of nucleons as input, which is ultimately Wood-Saxon. Depending upon momentum transfer value, it produces either minijet partons or strings. Zhang's Parton Cascade (ZPC) model deal with interaction of produced partons/strings. Deepending upon the fragmentaion scheme we choose as model input, it either use string fragmentation method or quark coalescence method.

In NLO we calculate charm distribution using the formalism given in [4]. CTEQ6.6 structure function is used for p+p system. EPS09 shadowing parameterization is added to incorporate cold nuclear effect. Effective transverse momentum kick added to explain multiple hard scattering or multiple soft rescattering within the cold nucleus (Cronin effect). For charm fragmentation, we have used Peterson et al. fragmentation function.

In addition to NLO result, FONLL [5] resums large perturbative terms at all orders. Here too, CTEQ6.6 parton structure function and EPS09 shadowing parametrization is used. Charm fragmentation function developed by Cacciari et al. is used here.

All the analysis carried out in the rapidity region $|y_{cms}| < 0.5$ for p+p and that for p+Pb is $-0.96 < y_{cms} < 0.04$. p+p yield was scaled with $T_{pp} = 1.39 \times 10^{-05} \mu b^{-1}$, while that for p+Pb was $9.83 \times 10^{-05} \mu b^{-1}$.

Results & Conclusion

In Figure 1 we have presented average R_{pPb} of D^0, D^+ and D^{*+} mesons in p+Pb data at $\sqrt{s_{NN}}$ = 5.02 TeV. For $p_T < 15$ GeV/c, Calculations from HIJING and AMPT underestimates the experimental data, though it shows shadowing effect in this transverse momentum window. In addition to shadowing, when we add effect of momentum broadening, NLO results roughly explains the data . Shadowing effect found to be small in magnitude in FONLL results for $p_T < 10$ GeV/c. Thus we conclude that, since R_{pPb} deviates from unity, thus initial cold nuclear matter effect

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*This study have been reported in [1]
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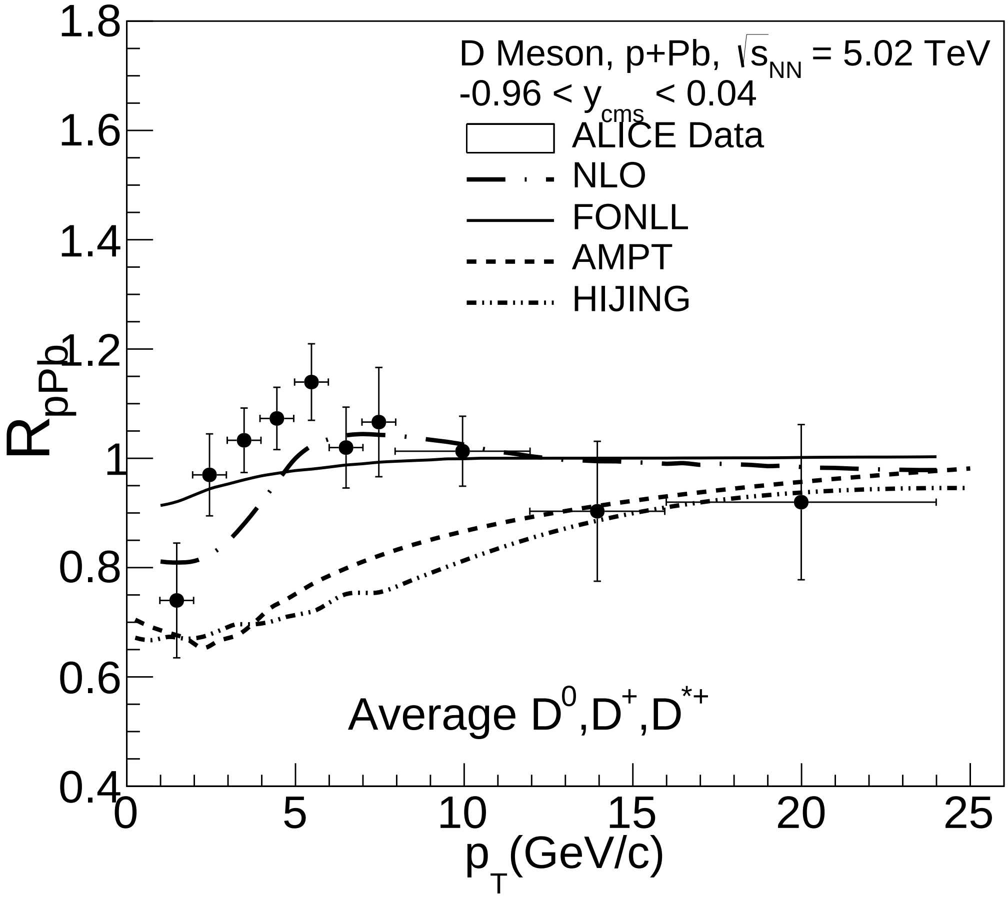

FIG. 1: Average nuclear modification factor for D-mesons in p+Pb collisions at $\sqrt{s_{NN}} = 5.02$ TeV.

have significant contributions in all models. In addition to shadowing effect, K_T broadening well explains trend and magnitude of the data within the errors.

References

[1] R.C.Baral, S.K.Tripathy, M.Younus, Z. Naik and P.K.Sahu arXiv:1606.07971

[2] X N Wang, M Gyulassy, Phys. Rev. D 44, 3501 (1991).

[3] Zi-Wei Lin, Che Ming Ko, Bao-An Li and Bin Zhang, Subrata Pal Phys. Rev. C 72, 064901 (2005).

[4] M. L. Mangano, P. Nason and G. Ridolfi, Nucl. Phys. B 373, 295 (1992); S. Frixione, M. L. Mangano, P. Nason and G. Ridolfi, Adv. Ser. Direct. High Energy Phys. 15, 609 (1998)

[5] M. Cacciari, M. Greco and P. Nason, JHEP 9805, 007 (1998); M. Cacciari, PoS HEP 2005, 137 (2006) [arXiv:hep-ph/0512251]