$\frac{\Lambda_c}{D^0}$ Ratio on High Multiplicity in pp collisions at LHC

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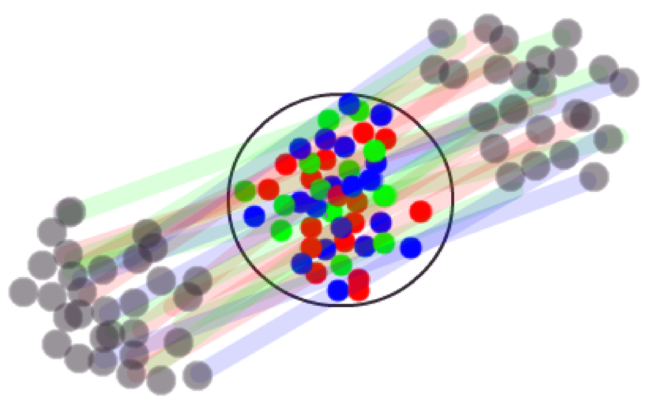
Abstract

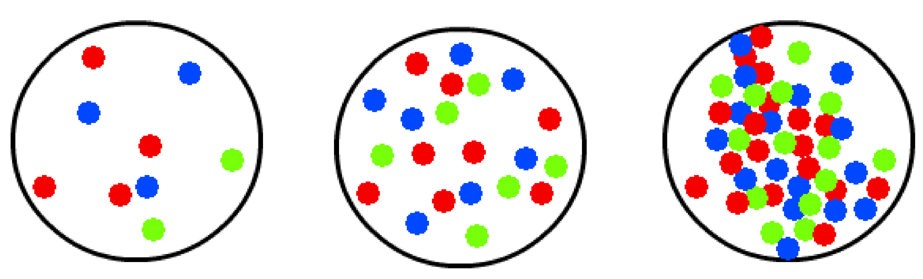
High multiplicity pp collisions had shown signals of the possible formation of a collective state on which the clustering color sources give a natural description of the production of strong color fields due to the partonic interactions. We explore the production of Λ_c/D^0 ratio on high multiplicity pp collisions as a consequence of the production of heavy flavors and the early time dynamics of the collisions.

The Model

The String Percolation Model (SPM), is based on a two dimensional percolation theory, which assumes that when a collision is placed, strings are present, at time that he strings are projected in the impact parameter plane small discs are formed with radius $r_0 = 0.25fm$ taking from QCD bilocal correlation Functions.



When the system reaches a critical density of strings, a cluster is formed, which indicates the presence of a geometrical phase transition and a connected system. In the model we define a quantity related with the fraction of area occupied by the discs, the Critical Parameter of String Color Density, defined as: $\zeta^t = (S_0/S)N^s$, where N^s is the average of the number of strings in the cluster: $N^s = 2 + 4\frac{S_0}{S}(\frac{\sqrt{s}}{m_p})^{2\lambda}$ which directly depends on the energy.



Fits

For this system the geometric scaling gives the Reduction Color Factor [1]: $F(\zeta^t) \equiv \sqrt{\frac{(1-e^{-\zeta^t})}{\zeta^t}}$. Where the transverse momentum distribution is given by:

$$\frac{1}{N}\frac{d^2N}{d\eta dp_T} = \frac{a\left(p_0\frac{F(\zeta_{pp})}{F(\zeta_{HM})}\right)^{\alpha-2}}{\left[p_0\sqrt{\frac{F(\zeta_{pp})}{F(\zeta_{HM})}}+p_T\right]^{\alpha-1}} \quad (1)$$

In this equation, a, p_0 y α are parameters obtained fitting minimum bias distributions for fixed energies:

$\sqrt{s}$	a	p_0	α
0.9	23.29 ± 4.48	$1.82 \pm .54$	9.40 ± 1.79
2.76	22.48 ± 4.20	$1.54 \pm .46$	7.94 ± 1.41
7	33.11 ± 9.31	$2.31 \pm .87$	9.78 ± 2.53

Table 1:Parameters for transverse momentum distributions.

By including the differentiation for the spectra by species for kaons (κ) and protons (p) [2],[3] we get:

$$\frac{1}{N}\frac{d^2N}{d\eta dp_T} = \beta \exp\left(\frac{-(m_{\kappa,p})^2F(\zeta_{pp})}{\langle p_T\rangle^2+\langle p_{\kappa,p}\rangle^2}\right)\frac{1}{N}\frac{d^2N}{d\eta dp_T}\Big|_{\pi} . \quad (2)$$

After some algebra steps, the production ratio function is obtain to fit it with the data obtained in [4]:

$$\frac{\frac{1}{N}\frac{d^2N}{d\eta dp_T}\Big|_{\Lambda_c}}{\frac{1}{N}\frac{d^2N}{d\eta dp_T}\Big|_{D_0}} = \frac{\beta\exp\left(\frac{-(m_{\Lambda_c})^2F(\zeta_{pp})}{\langle p_T\rangle^2+\langle p_{\Lambda_c}\rangle^2}\right)\frac{1}{N}\frac{d^2N}{d\eta dp_T}\Big|_{\Lambda_c}}{\beta\exp\left(\frac{-(m_{D_0})^2F(\zeta_{pp})}{\langle p_T\rangle^2+\langle p_{D_0}\rangle^2}\right)\frac{1}{N}\frac{d^2N}{d\eta dp_T}\Big|_{D^0}} \quad (3)$$

The Result

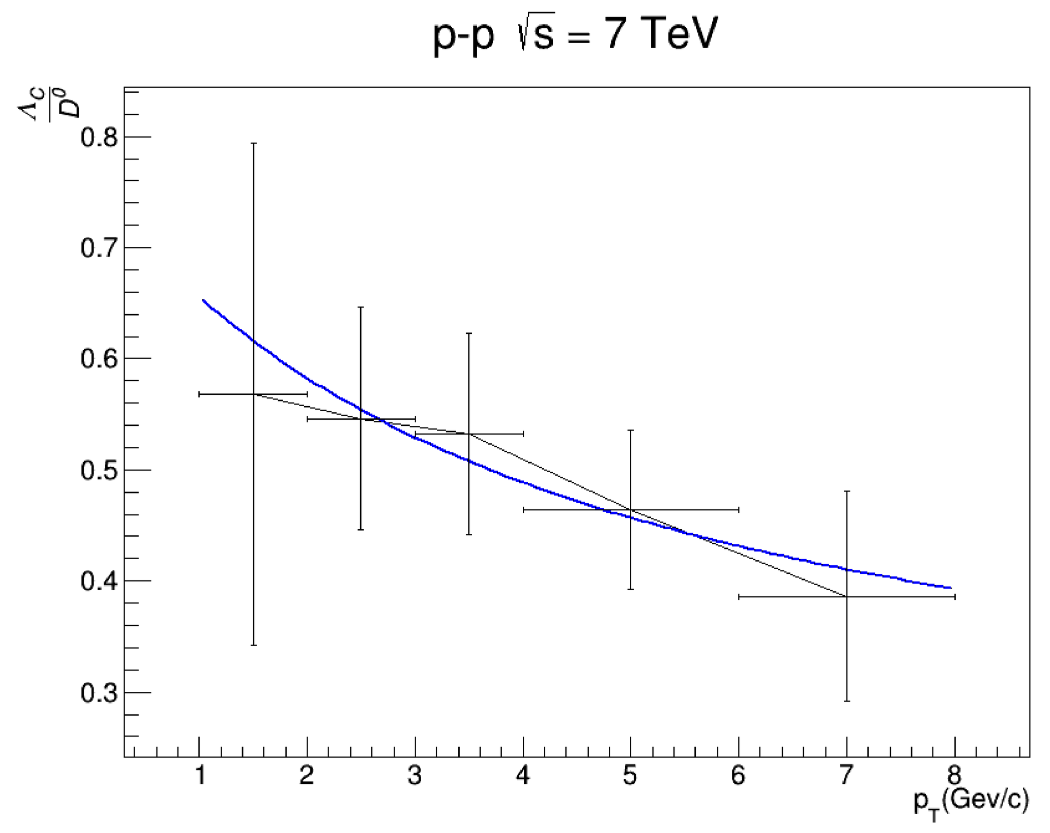


Figure 1:Fit for MinBias.

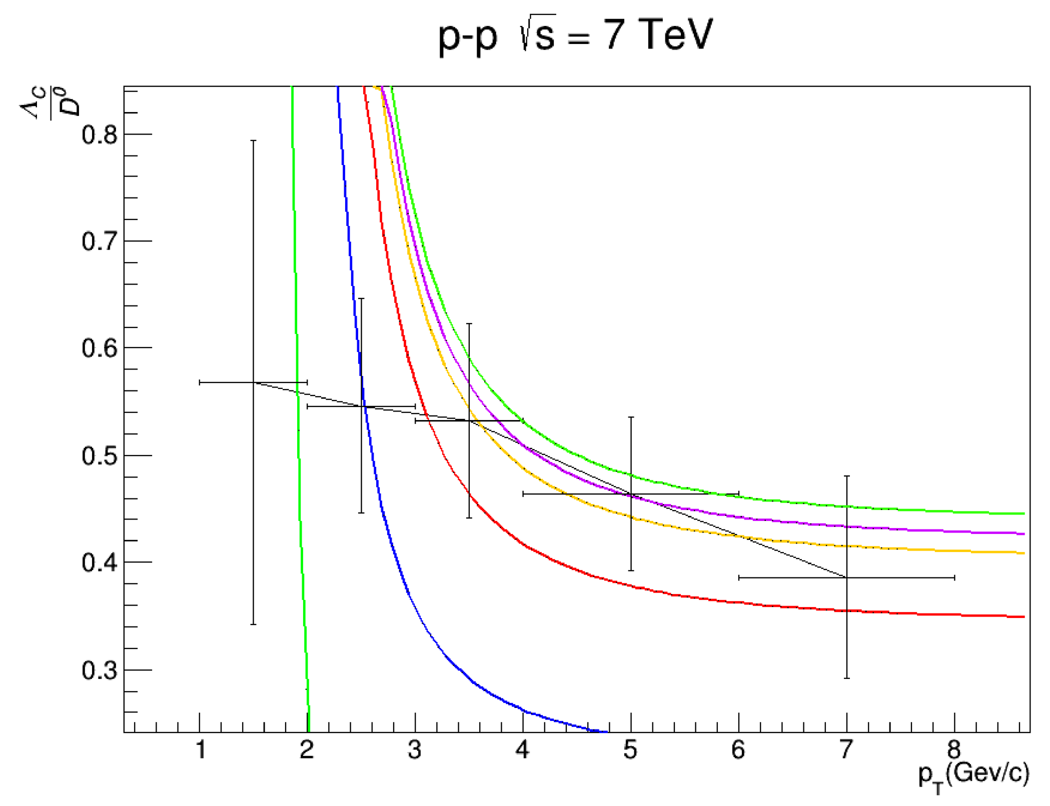


Figure 2:Fit with different multiplicity.

Conclusions

The fits were realized for MinBias and the results behaved as expected, all the data given by [4], fit with the theoretical part. The detail is that the available data are lacking of different multiplicity giving as result all the gaps in the investigation, trying to get further but having that inconvenient of the missing information. All the results about the different multiplicity class is just theoretical prediction using [5] for the fits of the different multiplicity class leaving the MinBias data as reference, expecting that when the data became available it behave as the results, changing the MinBias reference for the experimental data.

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References

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