Universal behaviour of transverse momentum distributions of mesons and baryons in the framework of percolation of strings

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Universality of transverse momentum distributions

- Introduction

- Universal p_T distribution

- The case of antibaryons(baryons)

- R_{AA},R_{CP} at RHIC and LHC

- pp

- Conclusions

Introduction

- Overlapping of strings forms clusters in transverse space.
- Each cluster has different color field $\longrightarrow$different tension
- $$< \mu >_n = \sqrt{\frac{nS_n}{S_1}} < \mu >_1 \;\; < p_T^2 >_n = \sqrt{\frac{nS_1}{S_n}} < p_T^2 >_1$$
- At high densities
  - $< \mu >_n = nF(\eta) < \mu >_1 \;\; < p_T^2 >_n = \frac{< p_T^2 >_1}{F(\eta)}$
  - $F(\eta) = \sqrt{\frac{1-e^{-\eta}}{\eta}}$, $\eta = N_S \frac{\pi r_0^2}{S_A}$
  - r_0 is the transverse size of a single string $\simeq$ 0.2 fm.

Universal p_T distribution

- p_T distributions will be the superposition of p_T distributions of clusters, each with a tension which depends on the number of strings of the cluster and its surface.

- $$f(p_T) = \int dx W(x) f(x, p_T)$$

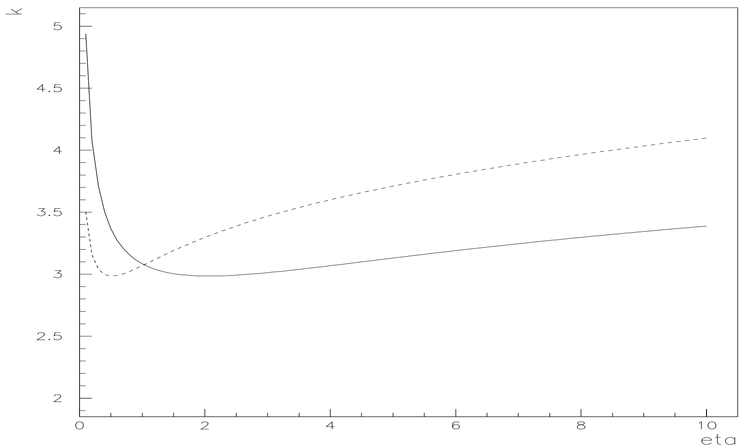
- $f(x, p_T)$ is the p_T distribution of cluster x

  $f(x, p_T) \simeq e^{-x p_T^2}$

- W(x) is the cluster size distribution

  $W(x) \simeq x^{k-1} e^{-k \frac{x}{<z>}}$

Universal p_T distribution



- $$\frac{1}{k} = \frac{<x^2> - <x>^2}{<x>^2}$$

  low density (only clusters of one string, $k \longrightarrow \infty$)
  very high density (one cluster with all strings, also $k \longrightarrow \infty$)

- This behaviour also explains the multiplicity and transverse momentum dynamical correlations.

Universal p_T distribution

- $$f(p_T,y) = \frac{dN}{dy}\frac{(k-1)F(\eta)}{k{<}p_T^2{>}_{1i}}\frac{1}{(1+\frac{F(\eta)p_T^2}{k{<}p_T^2{>}_i})^k}$$

- At low density $F(\eta) \longrightarrow 1$, $k \longrightarrow \infty$, $f(p_T,y) \simeq e^{-\frac{p_T^2}{{<}p_T^2{>}_i}}$

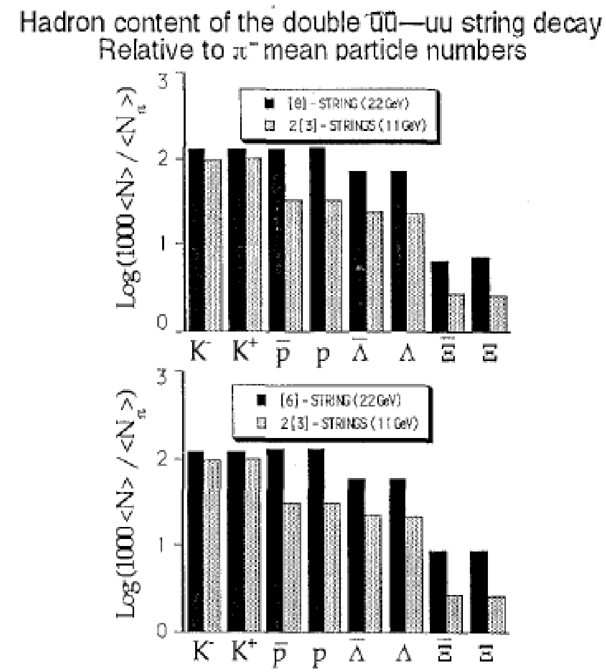
- At very high density,$k \longrightarrow \infty$,$f(p_T,y) \simeq e^{-\frac{p_T^2}{F(\eta){<}p_T^2{>}_i}}$

Universal p_T distribution

- A cluster composted of several $q-\overline{q}$ strings behaves as a $Q-\overline{Q}$ string with flavour composed of the flavour of the individual strings.

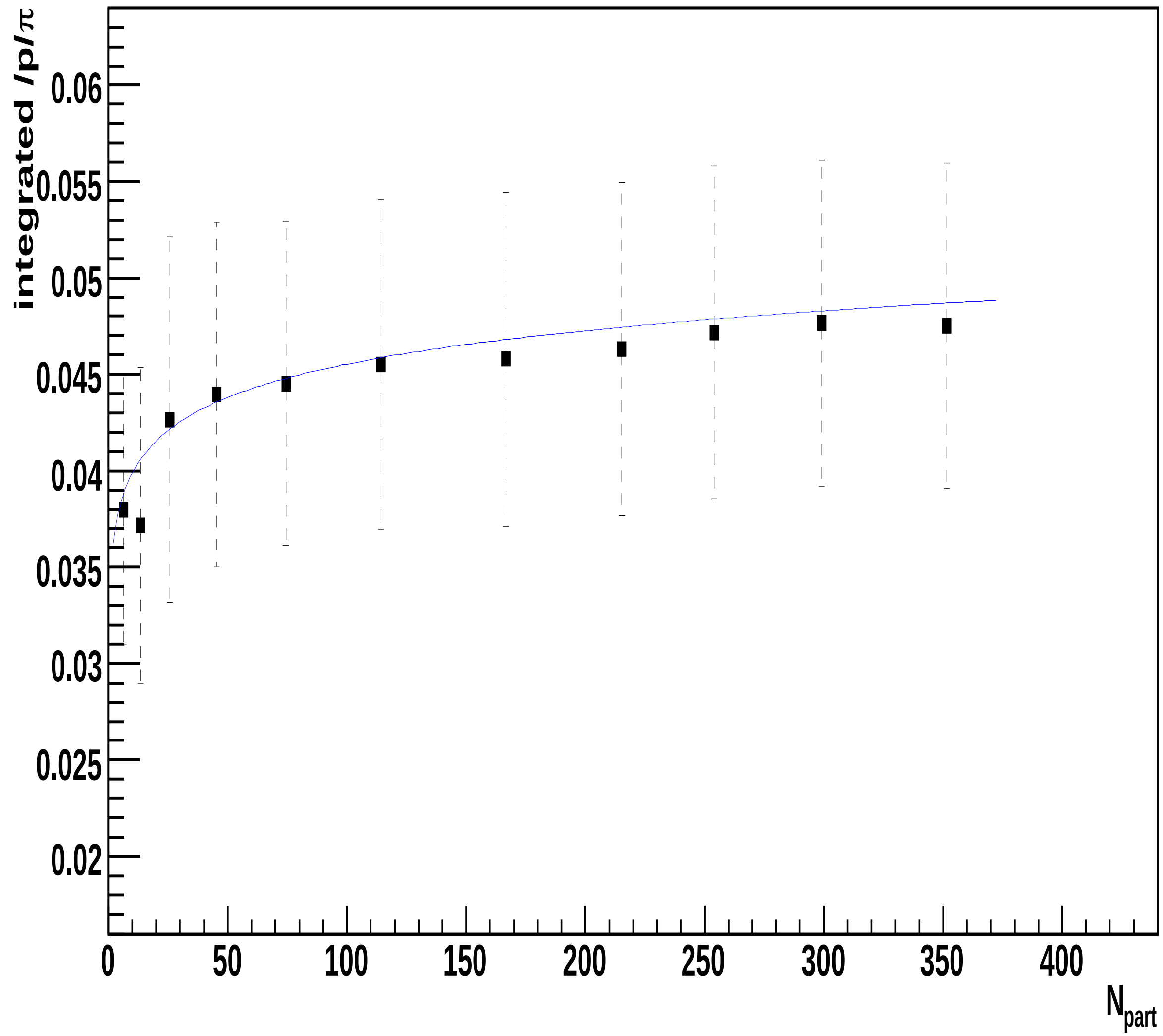
- The fragmentation is via the sucessive creation of pair parton complexes $Q-\overline{Q}$ until to come to masses comparable to observable hadrons.

- In this way, antibaryons(baryons) are enhanced over mesons.



Universal p_T distribution

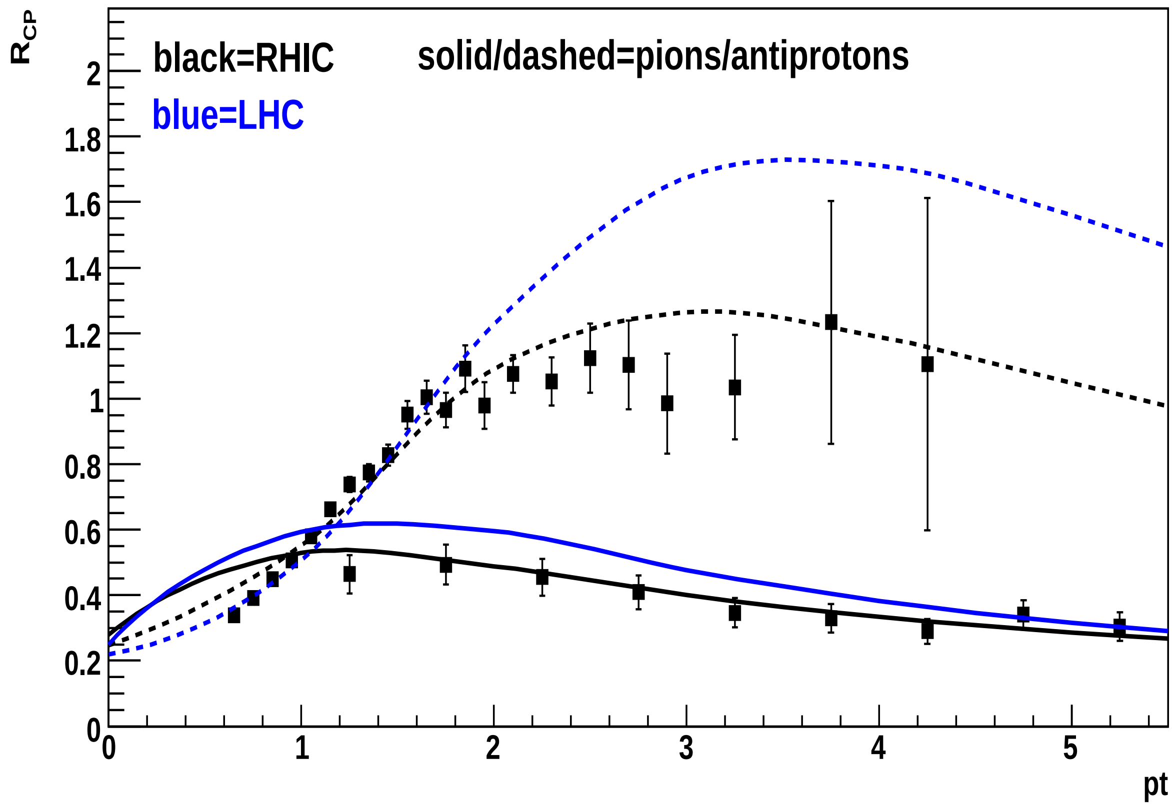
- $\mu_{\overline{B}} = N_S^{1+\alpha} F(\eta_{\overline{B}}) \mu_1^{\overline{B}}$
- $\mu_M = N_S F(\eta) \mu_1^M$
- From the dependence on N_{part} of $\frac{\overline{p}}{\pi}$ we obtain $\alpha =$0.09

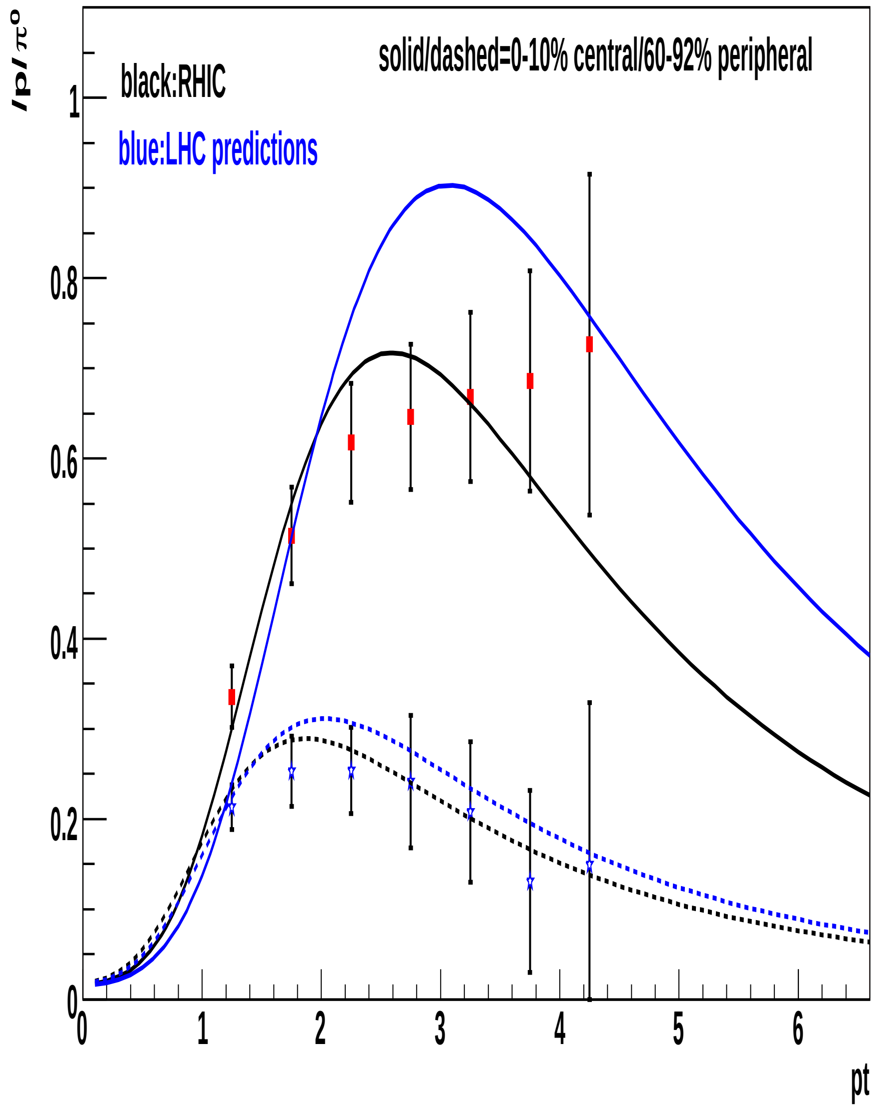


- (Anti)baryons probe higher densities than mesons

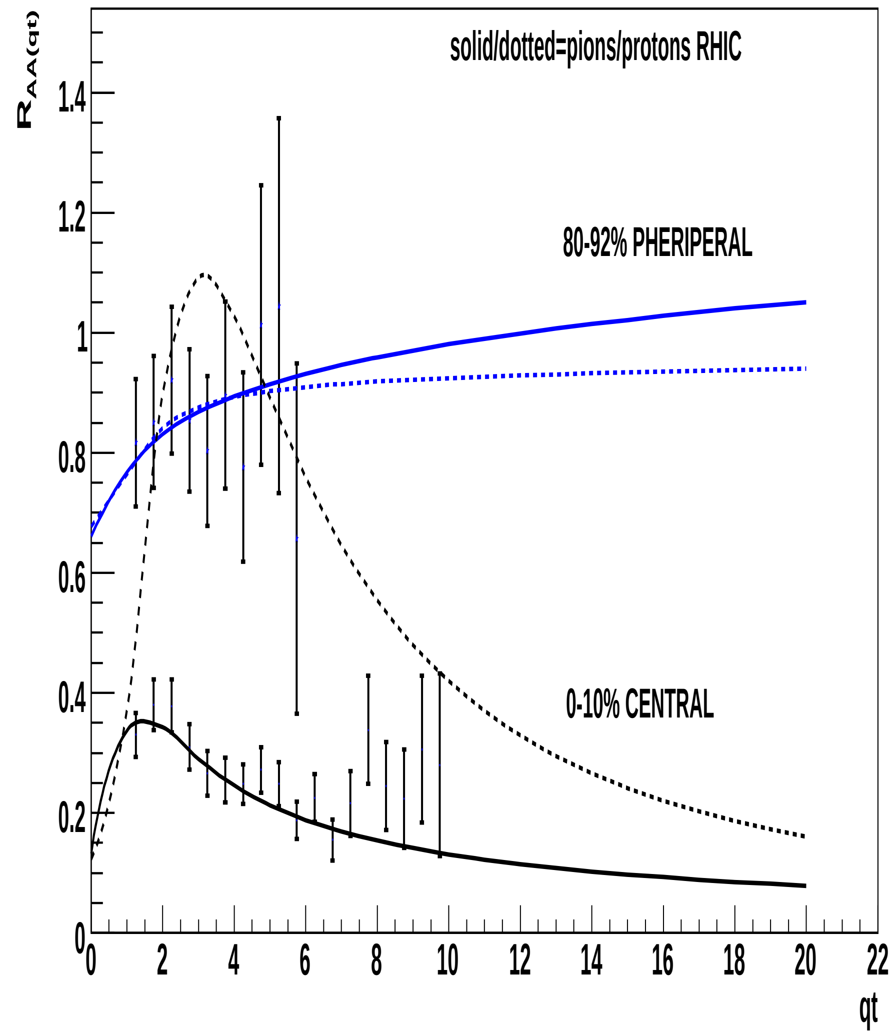
- $\eta \longrightarrow \eta_{\overline{B}} = N_S^{\alpha}\eta$

- $k_B = k(\eta_B) + 1$ (constituent counting rules)

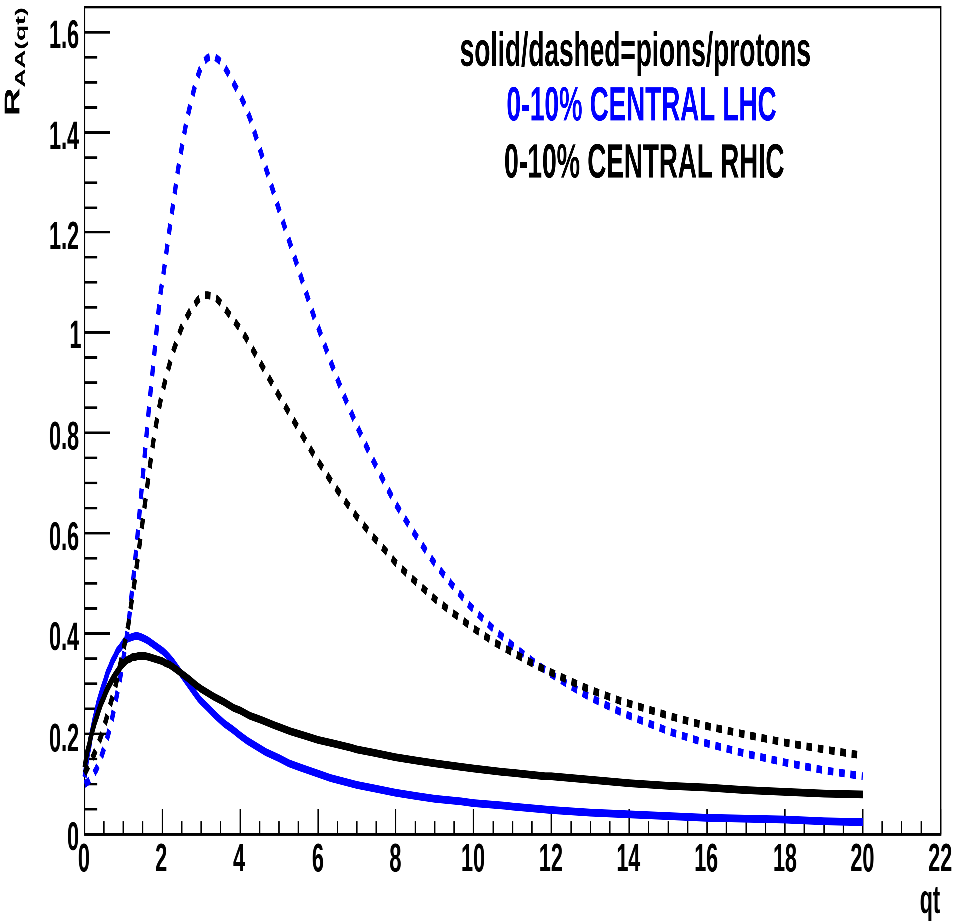




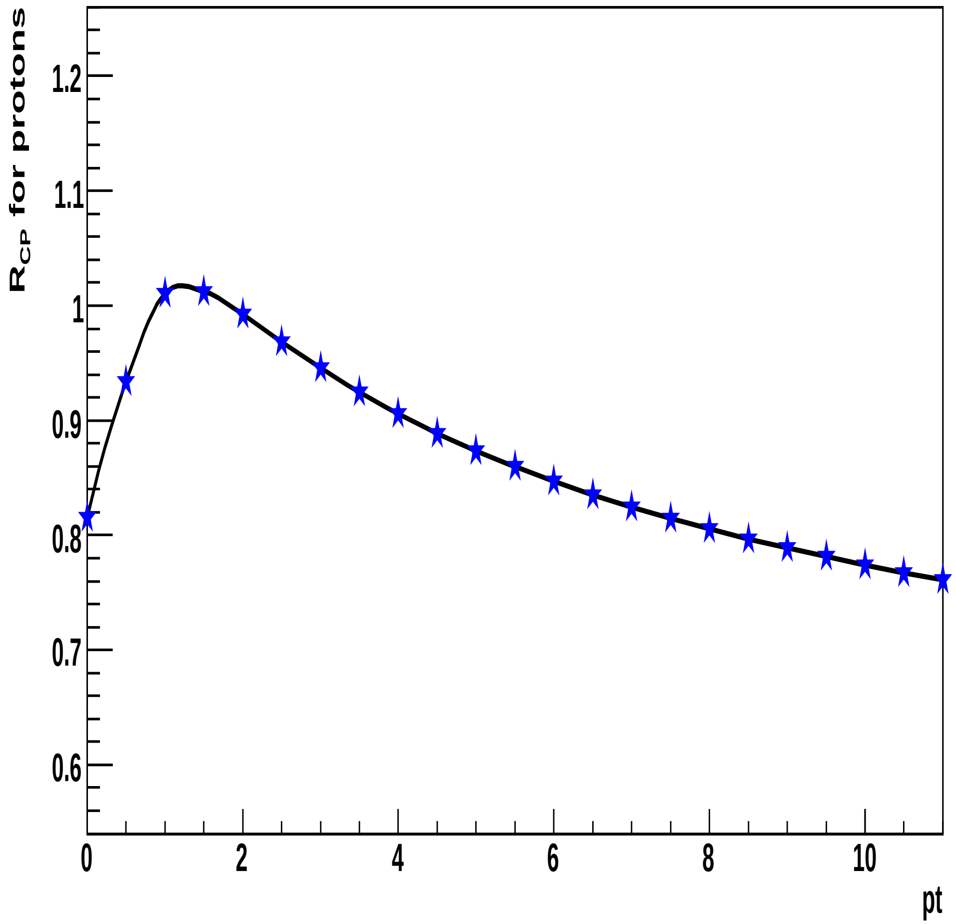
p/π^0
black:RHIC
blue:LHC predictions
solid/dashed=0-10% central/60-92% peripheral
pt



$R_{AA(qt)}$
solid/dotted=pions/protons RHIC
80-92% PHERIPERAL
0-10% CENTRAL
qt



$R_{AA(qt)}$
solid/dashed=pions/protons
0-10% CENTRAL LHC
0-10% CENTRAL RHIC
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
0
2
4
6
8
10
12
14
16
18
20
22
qt



R_{CP} for protons
0.6
0.7
0.8
0.9
1
1.1
1.2
0
2
4
6
8
10
pt

CONCLUSIONS

- A good description is obtained for mesons and baryons

- Cronin effect is enhanced for baryons in central collisions (R_{AA} and R_{CP})

- Percolation of strings incorporates naturally two effects: strong color fields, recombination or coalescence.

- pp for central collisions reach high density matter $\longrightarrow p_T$ supression