Rapidity dependence of the nuclear modification factor of identified hadrons in d+Au collisions

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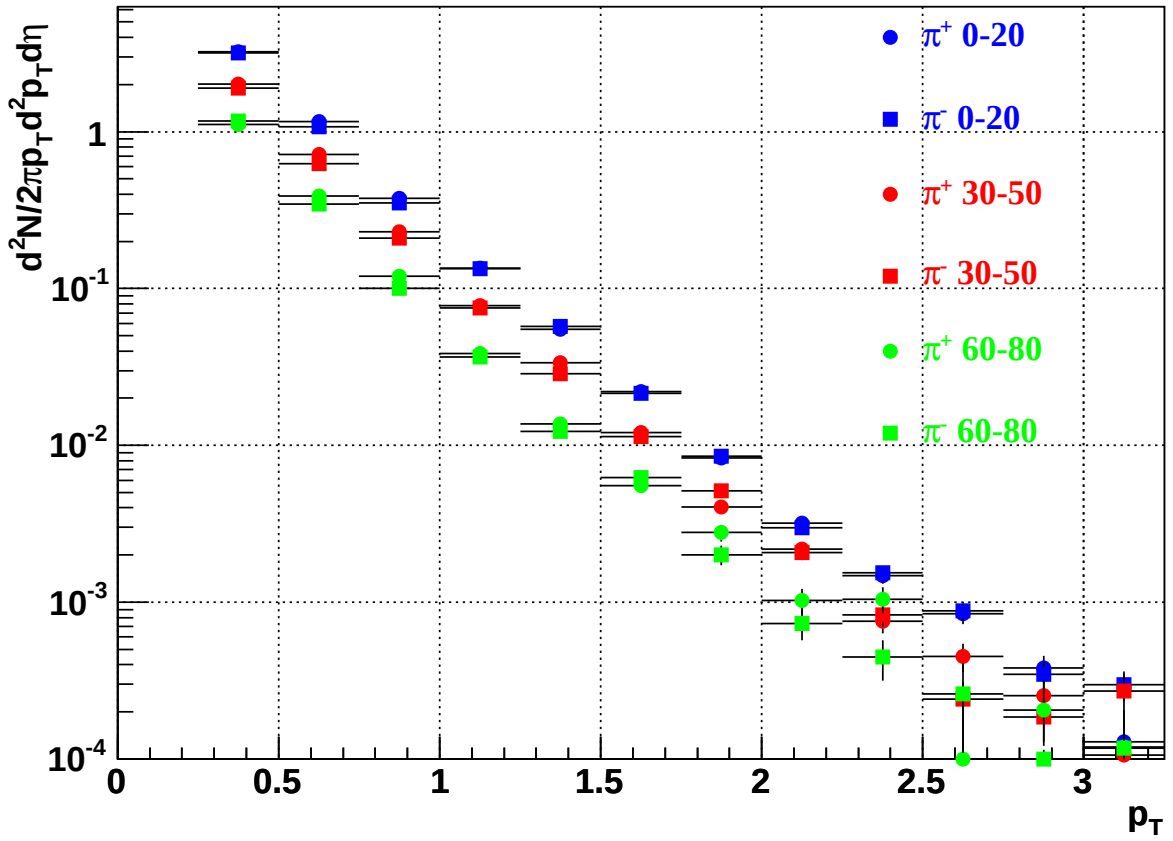
Abstract

BRAHMS' two rotatable magnetic spectrometers with particle identification capabilities for hadrons provide a unique possibility to study particle production in a broad range of both transverse momenta and rapidities. The transverse momentum distributions of pions, kaons and (anti-)protons, as well as their yields have been measured in d+Au collisions. The evolution of the rapidity spectra with centrality will be presented. The net-proton rapidity distribution can shed light on the nuclear stopping. The nuclear modification factors are calculated for different species at different pseudorapidities. The dependences of the Cronin effect on the species will be discussed. At forward rapidities, isospin effects and the contribution from protons are expected which can be distinguished by comparing the various species. Finally, the results will be compared to theoretical models which might be useful to clarify the role of e.g. parton saturation, shadowing or parton recombination.

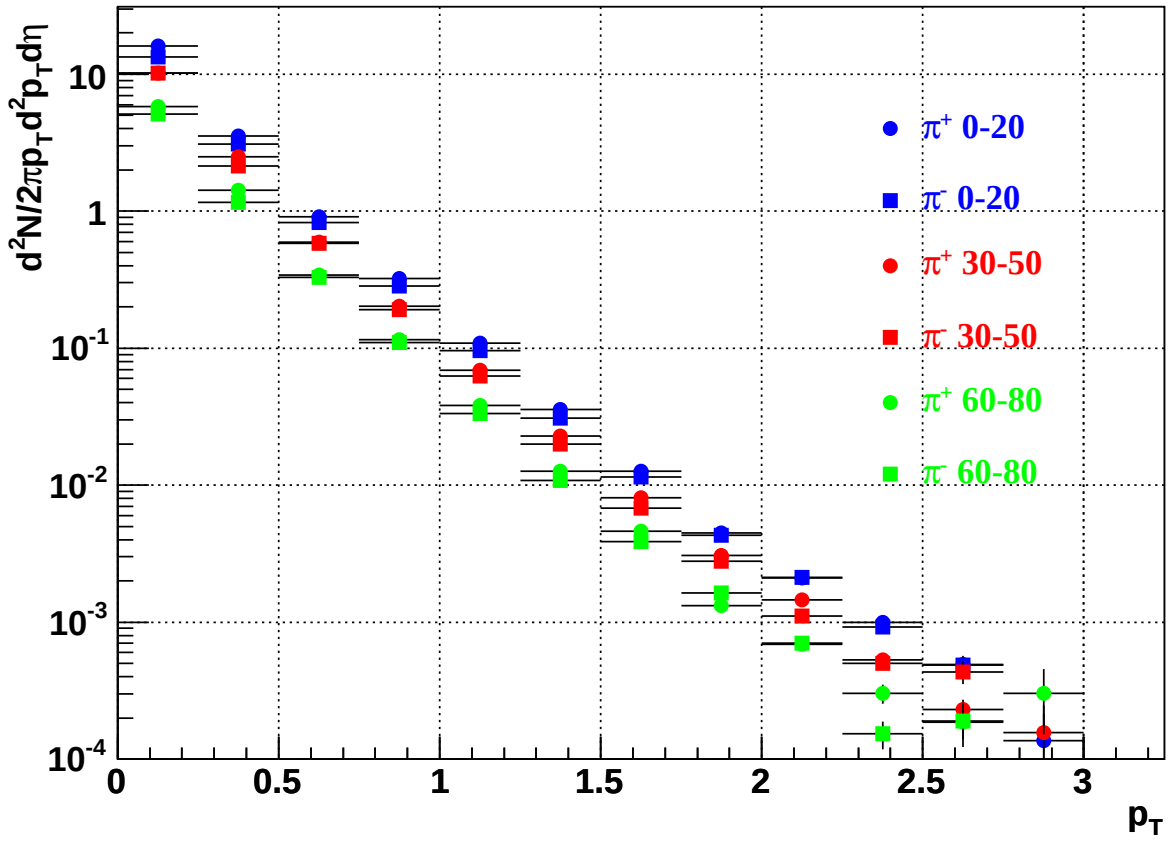
Plots included

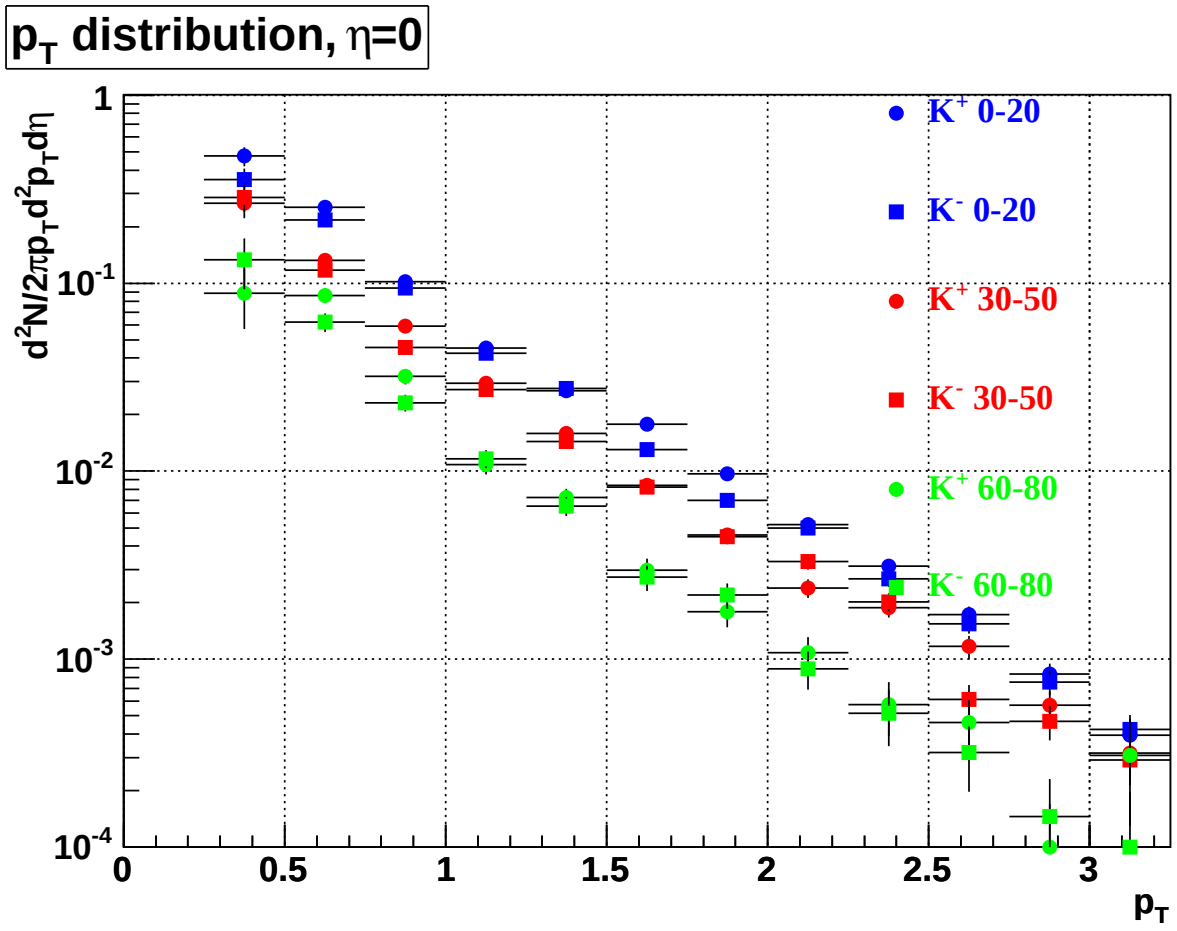
1. Transverse momentum distribution of identified particles in dAu collisions at $\sqrt{s}$=200GeV
2. Ratios of central to peripheral collisions: R_{CP} at $\eta = 0$, $\eta = 1$.
3. $dn/d\eta$ for identified particles at mid-rapidity

p_T distribution, η=0

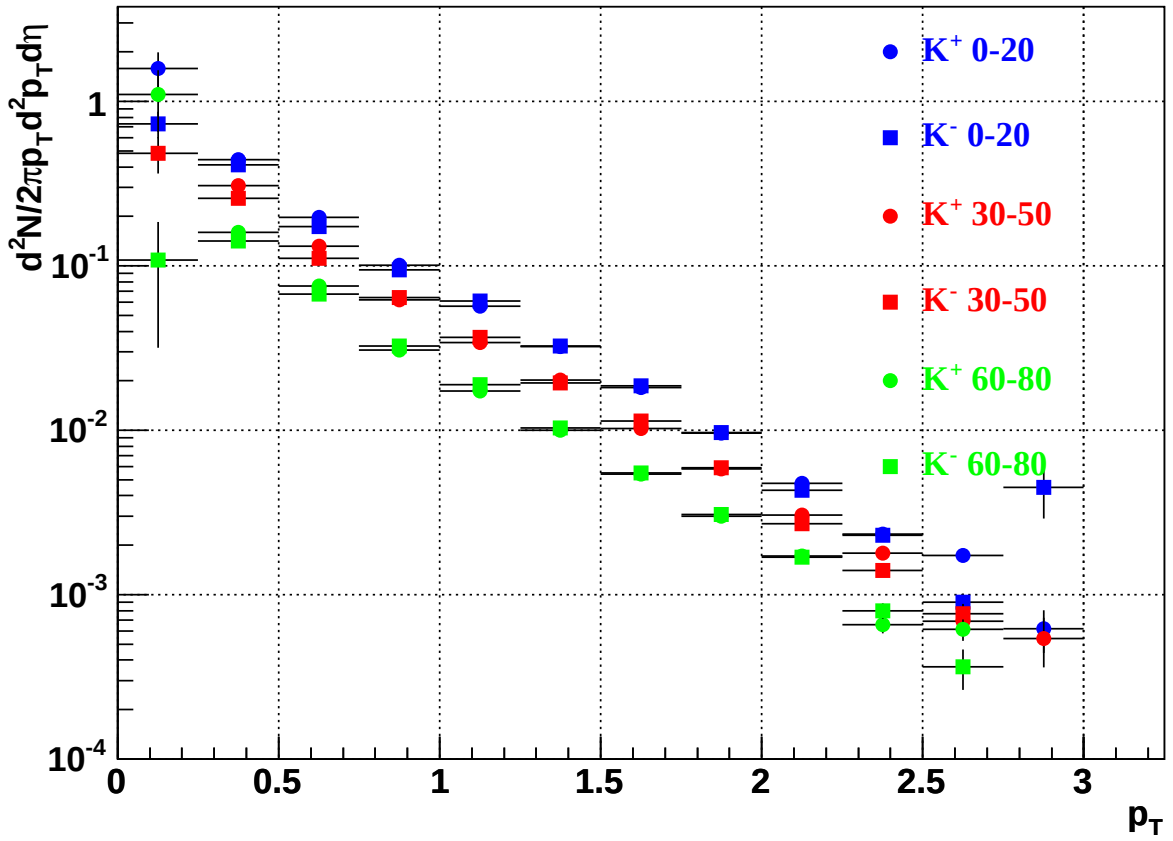


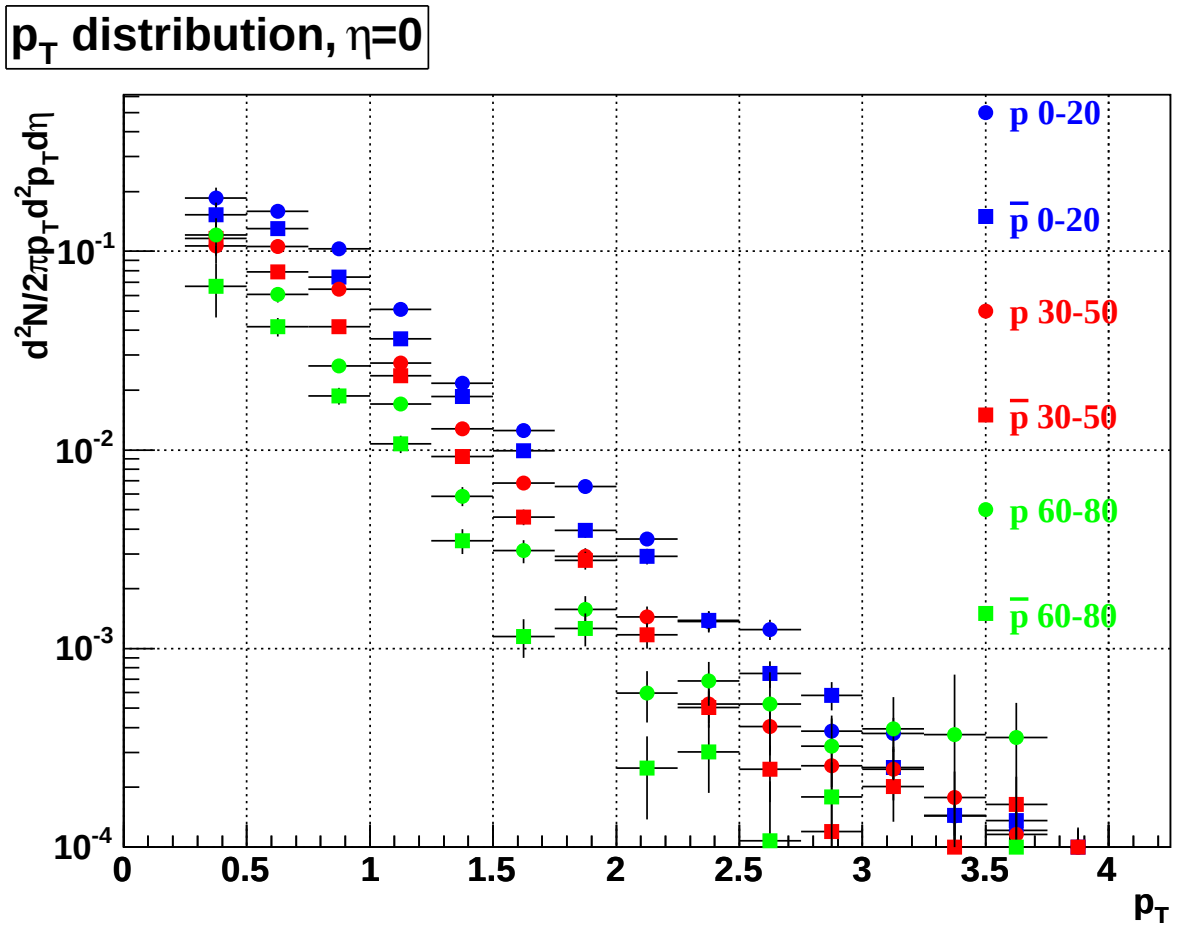
p_T distribution, η=1

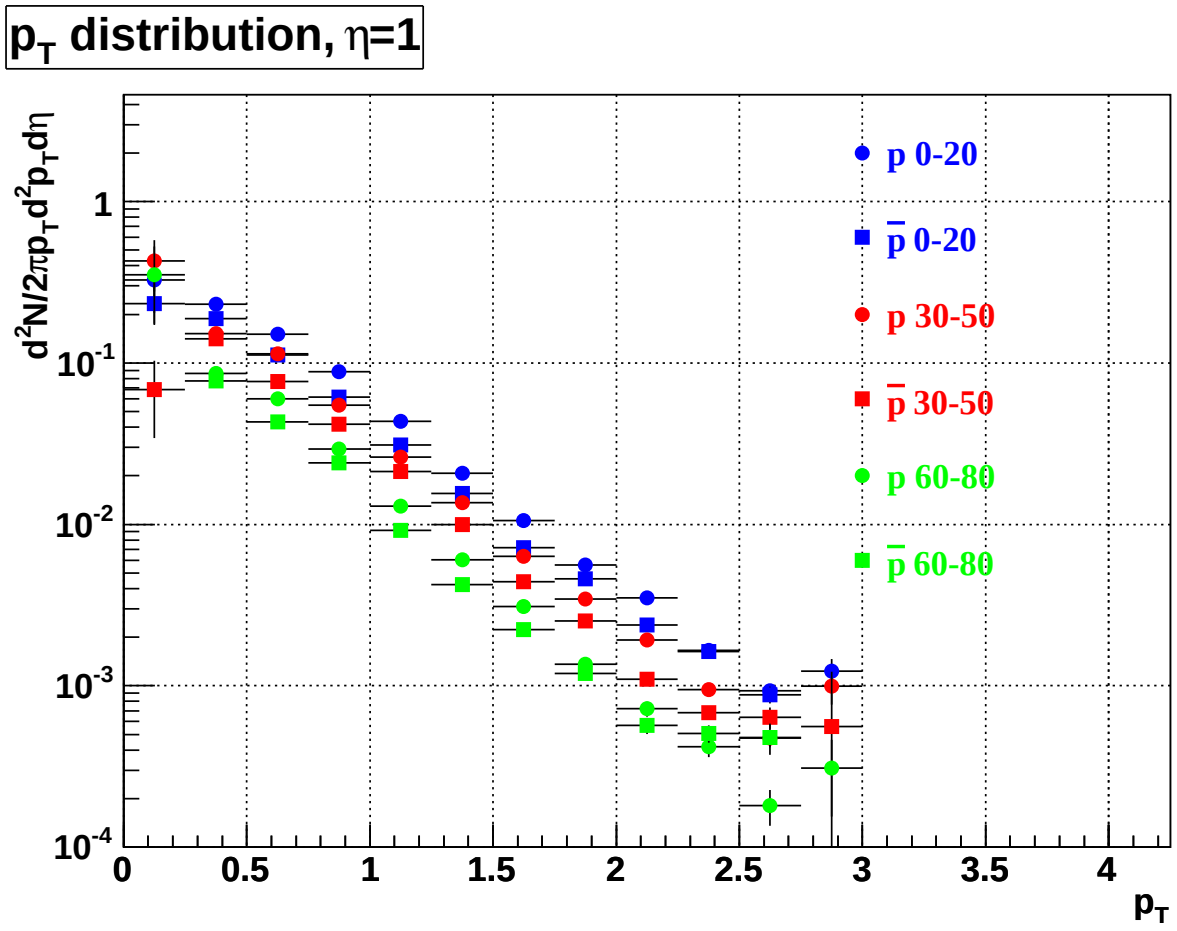



p_T distribution, η=0
$d^2N/2\pi p_T d^2p_T d\eta$
1
10^{-1}
10^{-2}
10^{-3}
10^{-4}
0
0.5
1
1.5
2
2.5
3
p_T
K^+ 0-20
K^- 0-20
K^+ 30-50
K^- 30-50
K^+ 60-80
K^- 60-80

p_T distribution, η=1

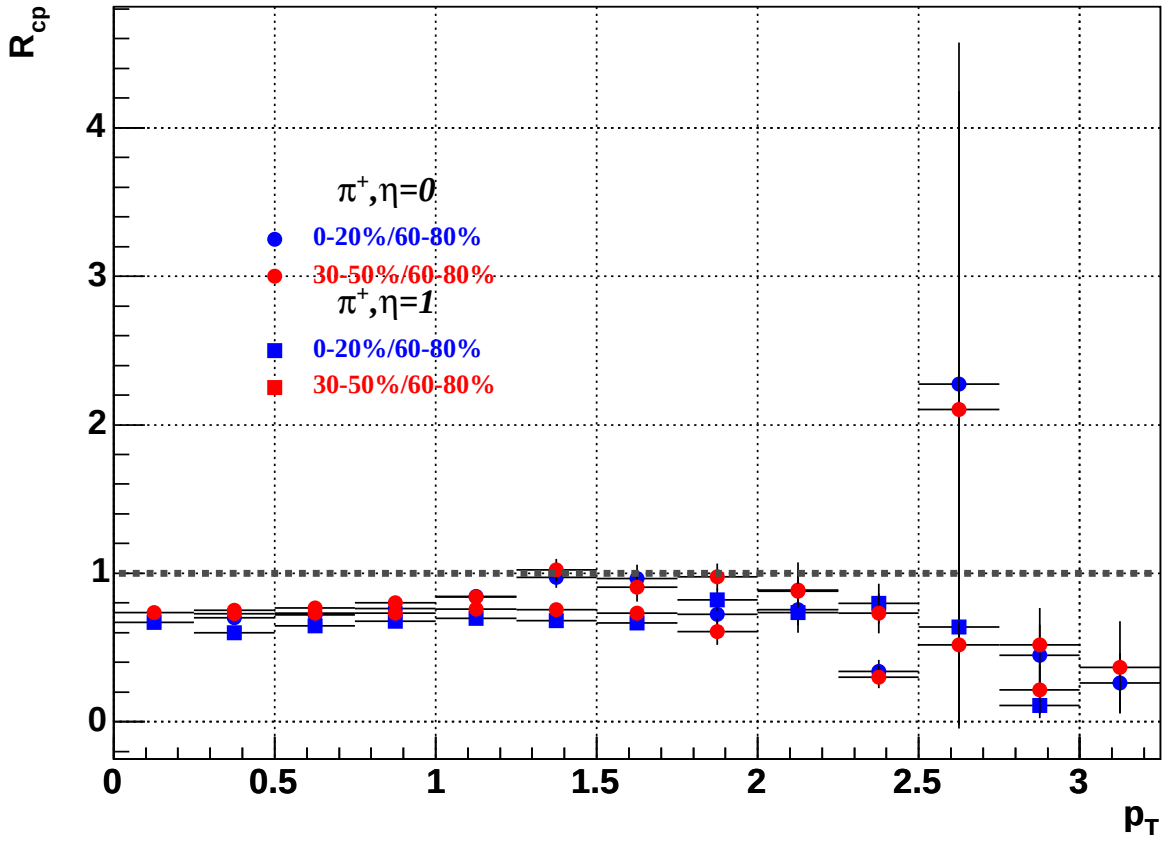



p_T distribution, η=0
$d^2N/2\pi p_T dp_T d\eta$
10^{-1}
10^{-2}
10^{-3}
10^{-4}
0
0.5
1
1.5
2
2.5
3
3.5
4
p_T
p 0-20
$\bar{p}$ 0-20
p 30-50
$\bar{p}$ 30-50
p 60-80
$\bar{p}$ 60-80

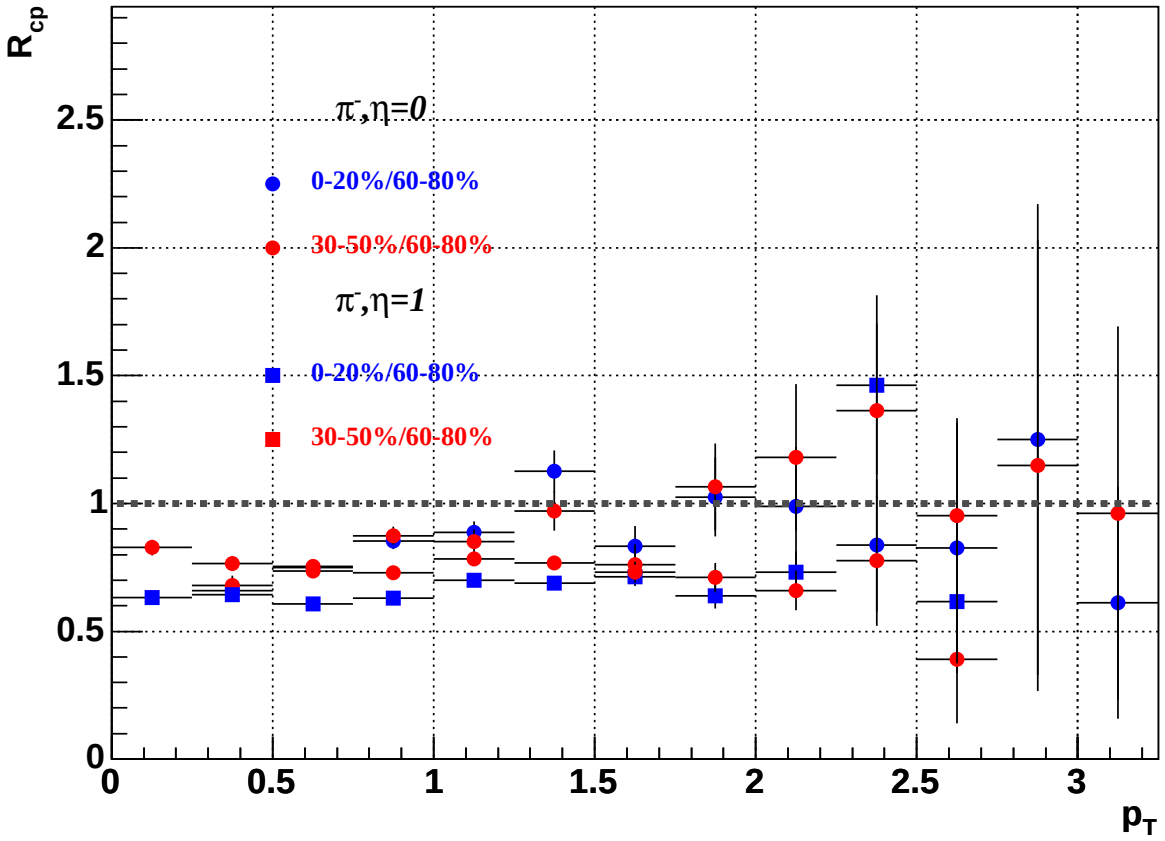

p_T distribution, η=1
$d^2N/2\pi p_T dp_T d\eta$
1
10^{-1}
10^{-2}
10^{-3}
10^{-4}
0
0.5
1
1.5
2
2.5
3
3.5
4
p_T
p 0-20
$\bar{p}$ 0-20
p 30-50
$\bar{p}$ 30-50
p 60-80
$\bar{p}$ 60-80

These p_T spectra has been used to obtain the particle yields and ratios R_{CP} by fitting with single exponential in pT.

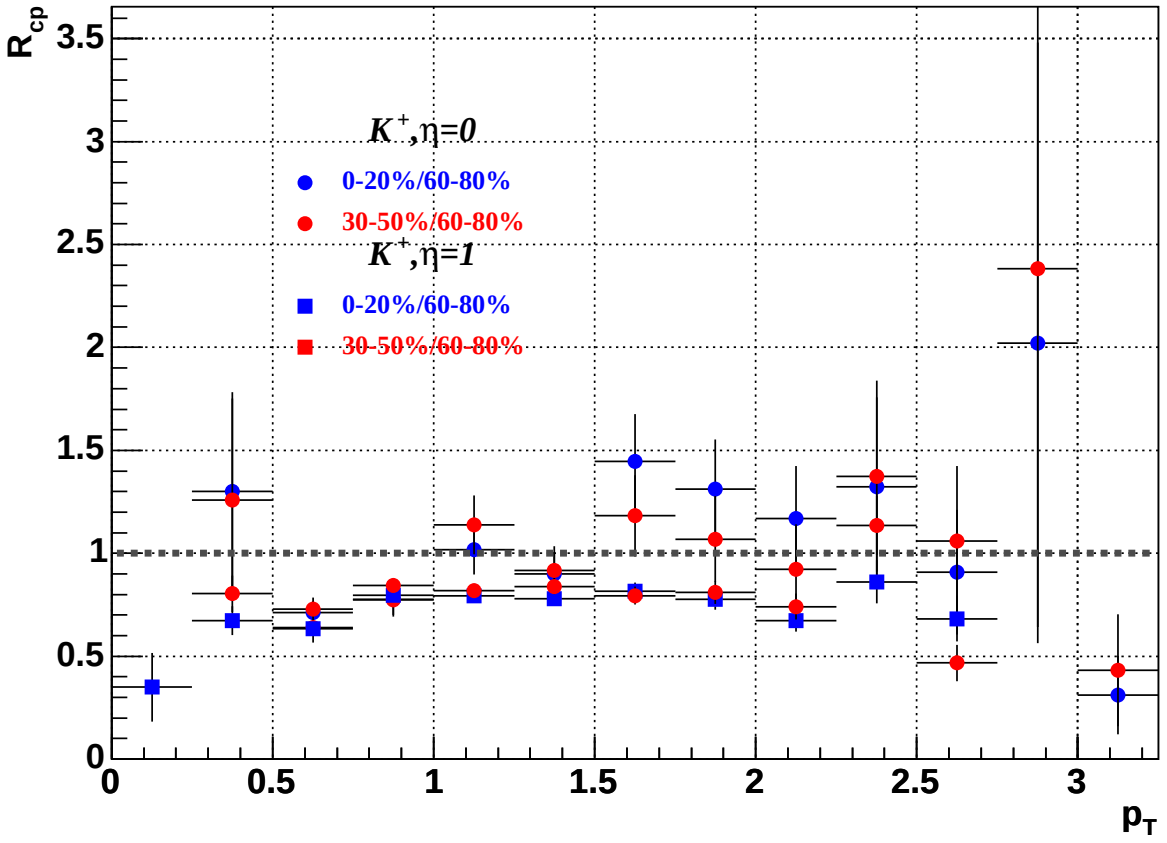
Identified particles nuclear modification factor in dAu 200GeV



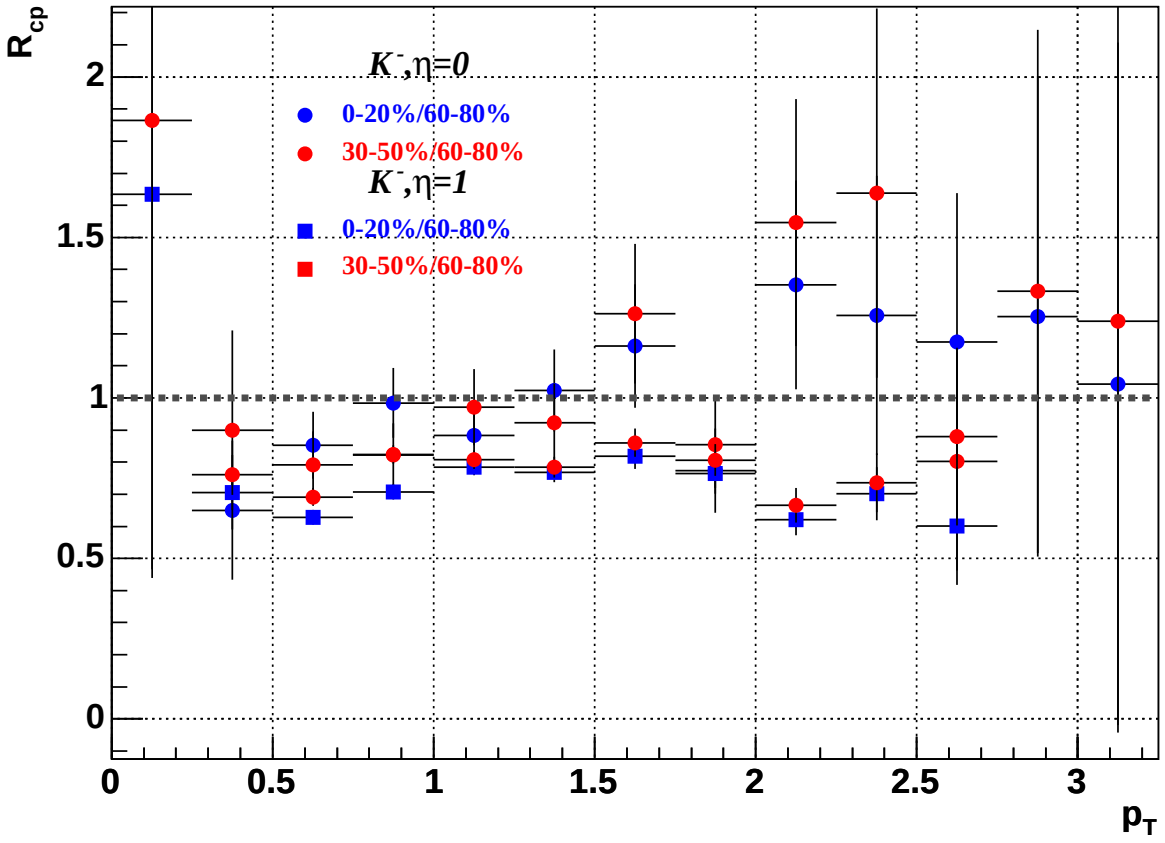
Identified particles nuclear modification factor in dAu 200GeV



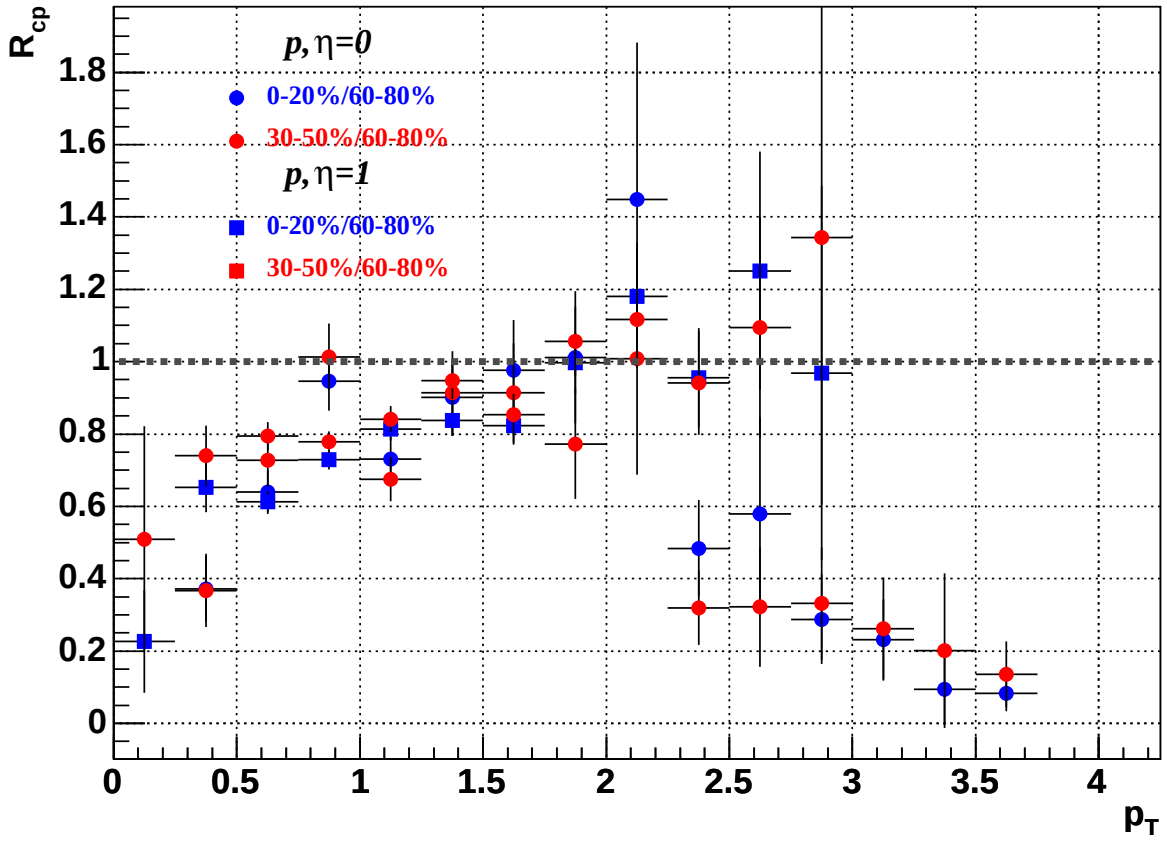
Identified particles nuclear modification factor in dAu 200GeV



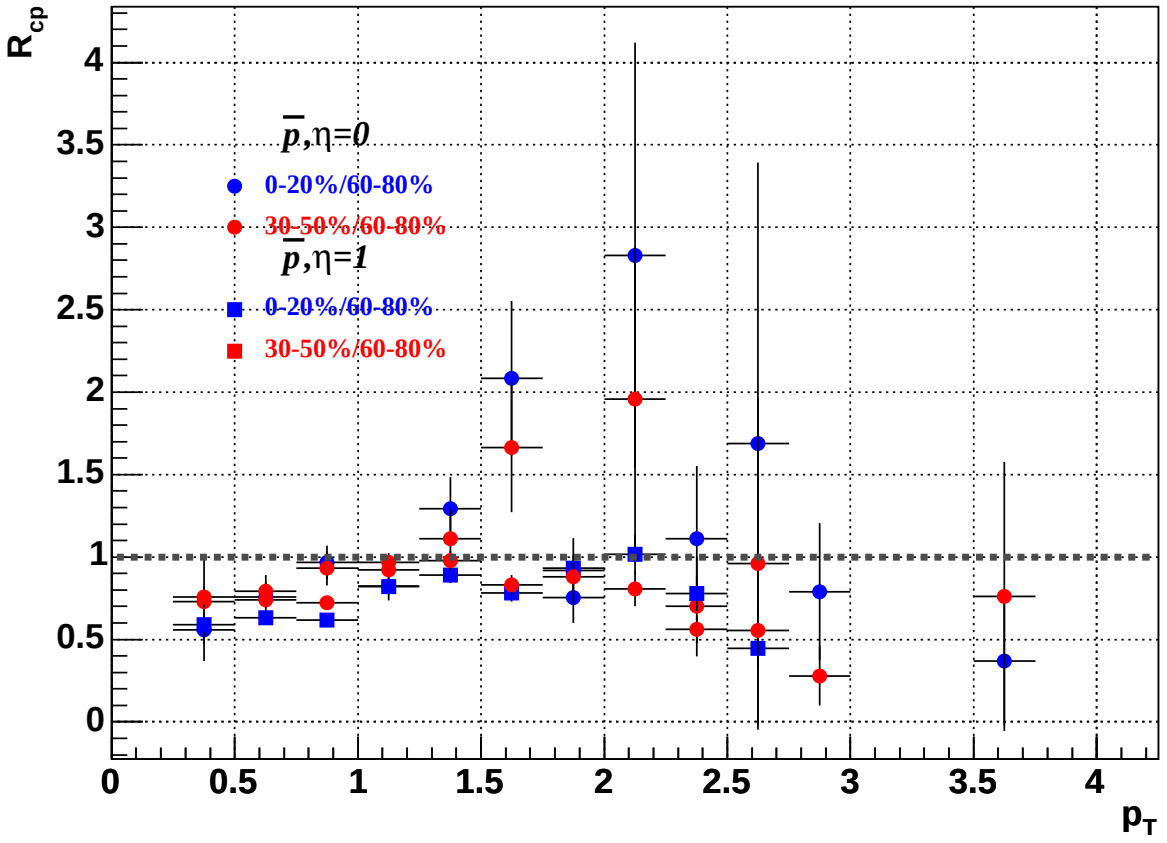
Identified particles nuclear modification factor in dAu 200GeV



Identified particles nuclear modification factor in dAu 200GeV

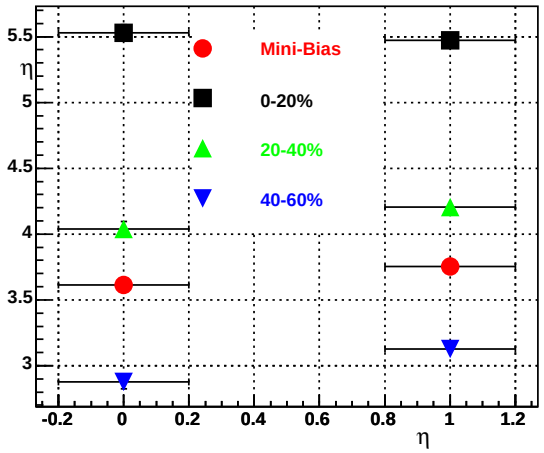


Identified particles nuclear modification factor in dAu 200GeV

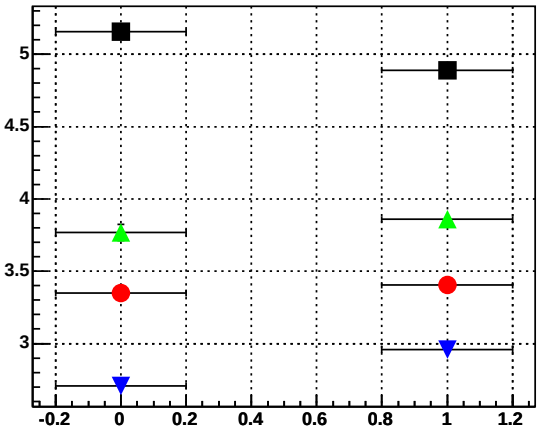


It is interesting to see the suppression of R_{CP} at higher rapidity for identified particles. The comparison to other experiment and Vogt's curve will be added after R_{dA} is made.

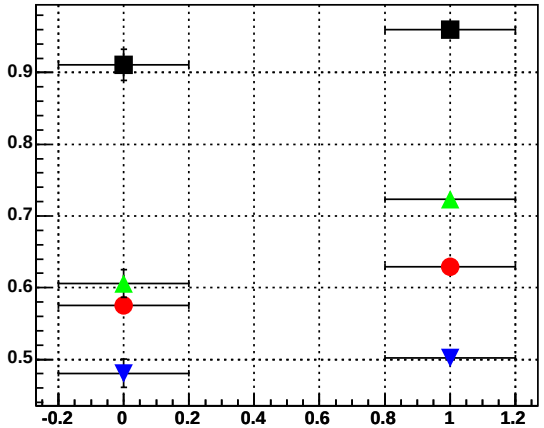
π^+ dN/dη at different centrality



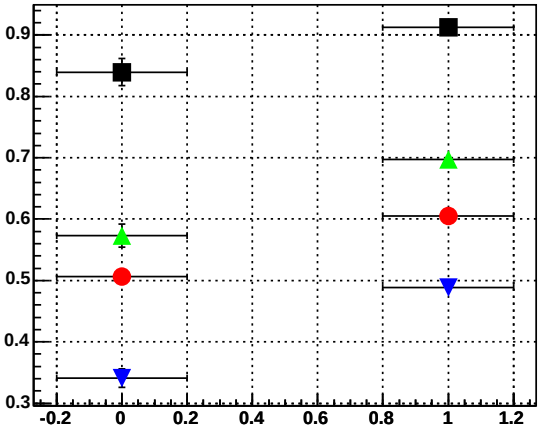
π^- dN/dη at different centrality



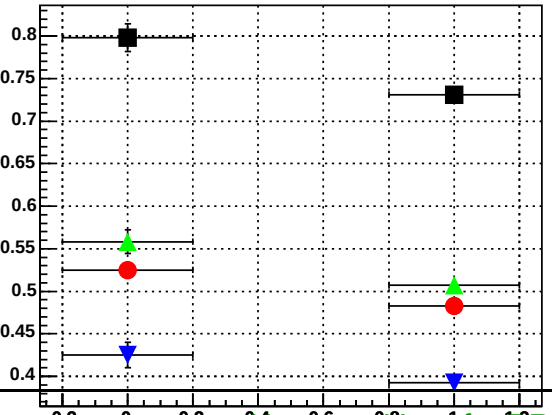
K^+ dN/dη at different centrality



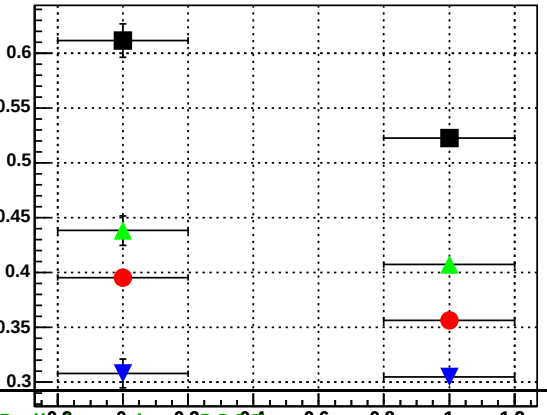
K^- dN/dη at different centrality



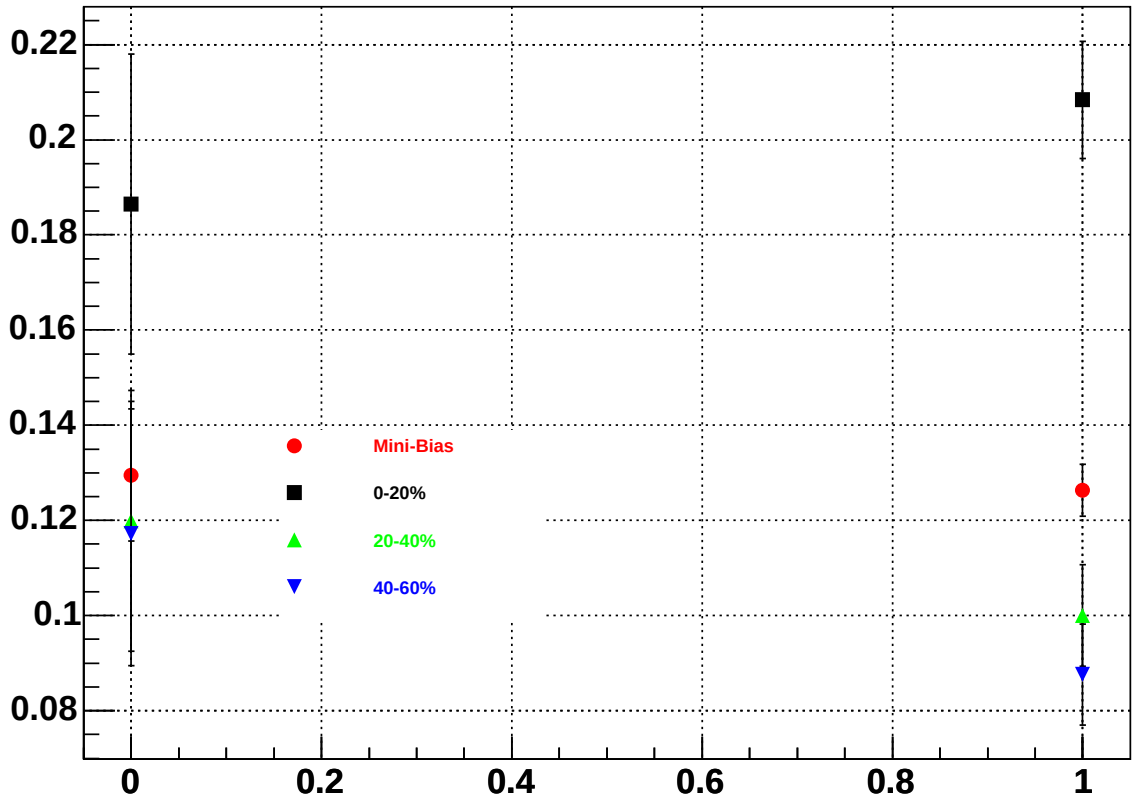
proton dN/dη at different centrality



anti-proton dN/dη at different centrality



net-proton dN/dη at different centrality



Identified particles' yields trend can be see at mid-rapidity, but the point at $\eta = 2.2$ will be very important for studying stopping in net proton plot. Hopefully, it can be achieved by better H1 and H2 pid improvement...

Problems and what can be expected

1. Need reference spectra of identified particles from pp data (Better to use our own pp reference, but I haven't got time to touch the pp data yet. Bjørn said he will work on it in July... Anyone has it at hand? If yes, could you spread it around since I guess I am not the only one who needs it)

2. For FS, low statistics is one problem, another problem is still lying in the H1 and H2 Pid ability - the efforts made to re-calibrate H1 and H2 (see page http://www.ift.uib.no/ hongyan/dau/content/calibration.html) did not help much in H1 and H2. Anyone experienced on this can help on this calibration? As to the analysis done up to now, we can have some identified particles spectra only from pid performed by RICH from the 8deg and 12deg mid-field(843) runs with low statistics and large error bars, and 4deg full field runs and some lower field runs can be used(plots are not included here yet).

3. Efficiency(tracking and cut) and correction(decay, multiple scattering and hadronic absorption) issues will be considered carefully before the final results come into form.

4. Plan to add some MRS runs(7615-7893, 8307-8361) into account to reduce the statistical error by implement a constant shift(by hand) to $1/\beta$ vs momentum, I am pretty sure that can be finished before late June. (if it is ok to make this shift by hand? In fact, it is the problem with TOFW calibration. If the TOFW calibration was done properly, this constant shift should not be in the DST).

5. Comparison with models and other experiments will be made before end of June.

Anything missing needs to be considered?

References

1. Some BRAHMS published papers, some PhD thesis related, and analysis notes (to be specified later)

2. Papers as to this topic from other experiments (to be specified later)

3. R. Vogt, hep-ph/0405060

   Shadowing Effects on the Nuclear Suppression Factor, R_{dAu} in d+Au Interactions

4. R. C. Hwa, C.B. Yang and R. J. Fries, nucl-th/0410111

   Forward Production in dAu Collisions by Parton Recombination

5. A series of paper as to CGC . . . (to be specified later)

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Comments and Suggestions?

Would you please send your comments to Hongyan.Yang@ift.uib.no?

Thanks a lot for your kind help!