ANALYSIS OF DIFFERENCES ON PSEUDORAPIDITY MULTIPLICITIES SPECTRUM AT LHC AND UA1/UA5 EXPERIMENTS

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September 12, 2012

Background of this work is an ATLAS CMS and ALICE experimental observation that UA1 spectra is significantly higher (by ~ 1.15) than LHC one. Our research groups explain this effect by actual difference at pp and $p\bar{p}$ inclusive spectra, but experimenalists explain this observation by UA1 specific procdeure of selecting NSD events by two-arm trigger. Analysis of two-arm UA1 trigger and comparing one with ATLAS, ALICE and CMS triggers is not a subject of this work.

I analyse here only rapidity spectras of produced particles at LCH and UA1/UA5.

Atlas and UA1 experiments reports pseudorapidity multiplicity spectrums at different transverse momentum ranges, whole range $p_t > 0Gev$ for UA1 and $p_t > 500Mev$ [arxiv:1003.3124] for ATLAS. So, to compare this datas, one should to estimate $\frac{dN}{d\eta}(p_t > 500Mev)$ from generic UA1 data and compare with ATLAS data.

UA1 gave parametrisation of p_t distribution in form

$$E\frac{d^3\sigma}{dp^3} = A(1 + p_t/p_{t0})^{-n} \quad (1)$$

with $A = 382, p_{t0} = 1.56, n = 9.96$ at $\sqrt{s} = 900 GeV$.

From this parametrisation, we get correction

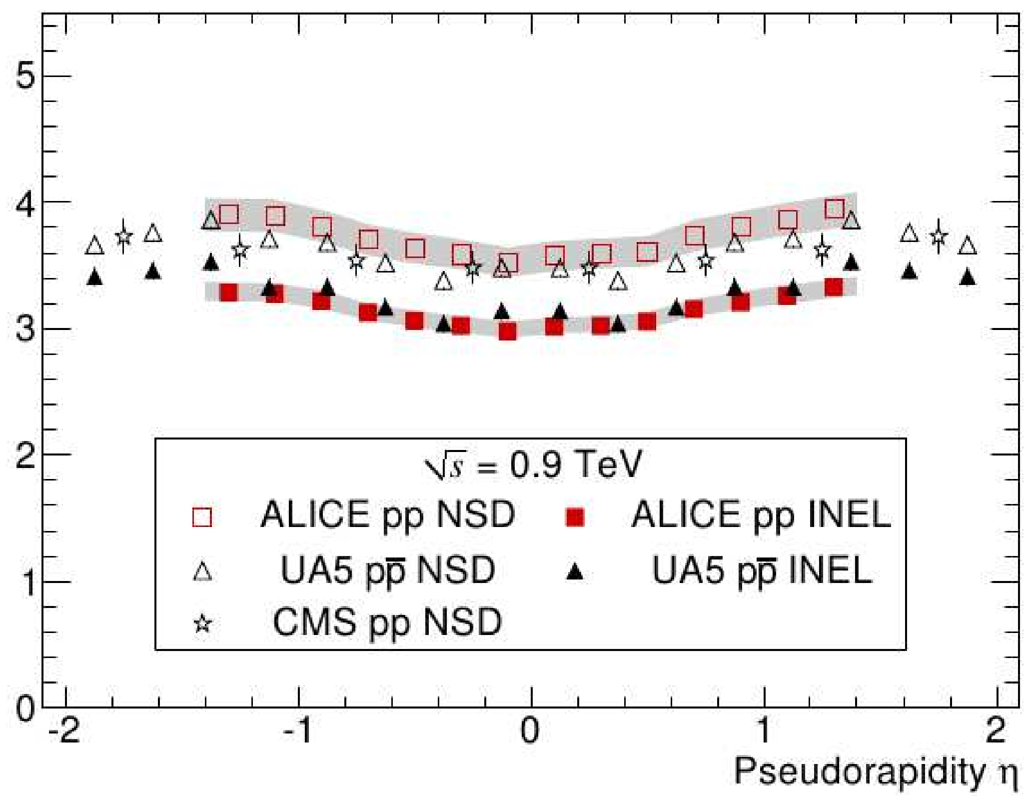
$$\frac{dN}{d\eta}(p_t > 500 Mev) = \quad (2)$$

$$\frac{dN}{d\eta}(p_t > 0 Mev) \times \frac{\int_{500Mev}^{\infty} p(1 + p_t/p_{t0})^{-n} dp_t}{\int_{0Mev}^{\infty} p(1 + p_t/p_{t0})^{-n} dp_t} \quad (3)$$

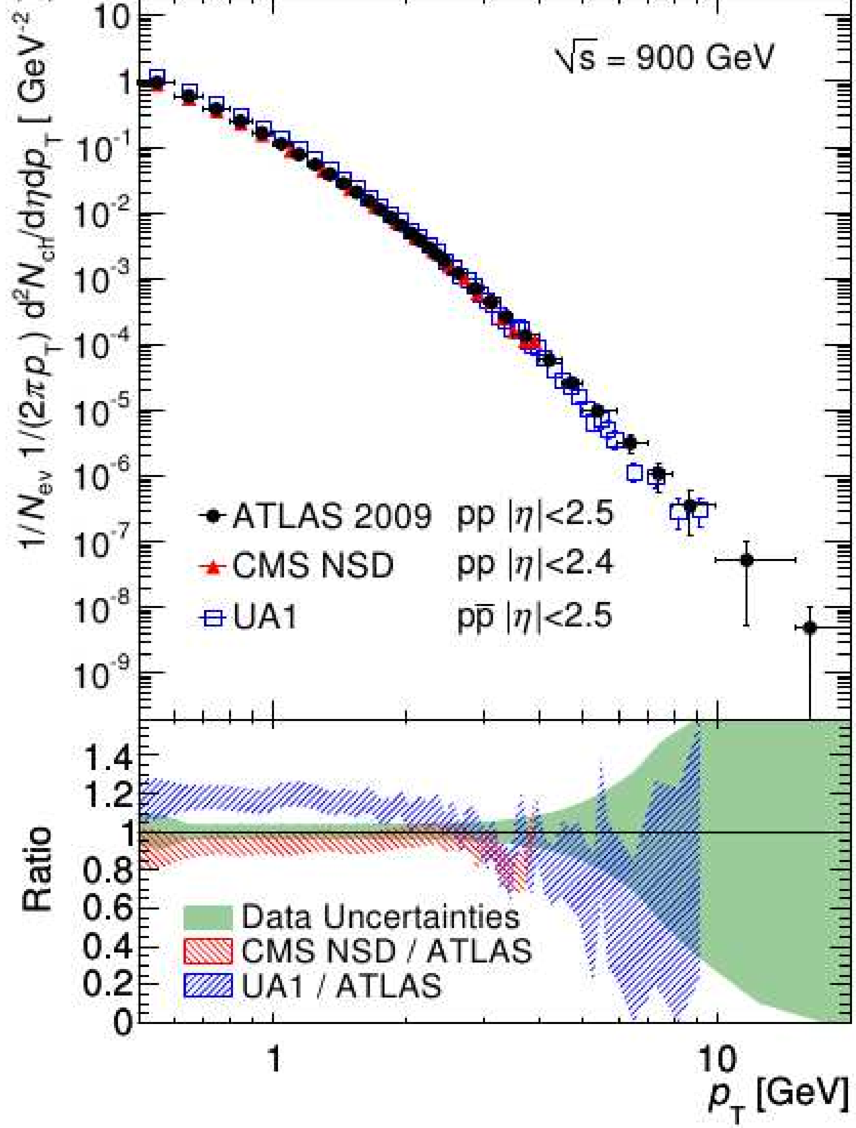
$$= 3.48 * 0.32 = 1.11 \quad (4)$$

The ATLAS value ~ 1.35 is higher than this estimation.

The same analysis for later ATLAS [arxiv:1012.5104] for $\frac{dN}{d\eta}(p_t > 100Mev) \sim 3.5$ gives lower 3.14 estimation from UA1. ALICE [arxiv:1004.3034] and CMS get the same or slightly higher multiplicity, than UA1 and UA5 experiments.



This values of $\frac{dN}{d\eta}$ is in clear contrast with analysis of p_t spectra, there UA1 data is 15% higher than ATLAS, CMS an ALICE data.



So, the question is, how to remove this inconsistency and what kind of data we must prefer for analysis.

ALICE data is accurate enought down to 100Mev. Fraction of particles in umeasured area is above 5%.

In UA1 and UA5 data obtained only down to 250Mev. Fraction of particles in umeasured area is above 35%. So, the ambiguity of continuation to low transverce momenta may be sufficient and give additional systematic uncertainty to rapidity spectra.

Equality of pp and $p\bar{p}$ inclusive cross sections is commonly used. This work is based on assumption about significant difference of pp and $p\bar{p}$ inclusive cross sections, and, so, we can not use ALICE (or other LHC experiments) data for determination of continuation UA1 $p\bar{p}$ spectra to low p_t.

In UA1 original paper exponential continuation to low p_t was developed:

$$E\frac{d^3\sigma}{dp^3} = Be^{-bm_t} \text{ for } p_t > p_t^* \tag{5}$$

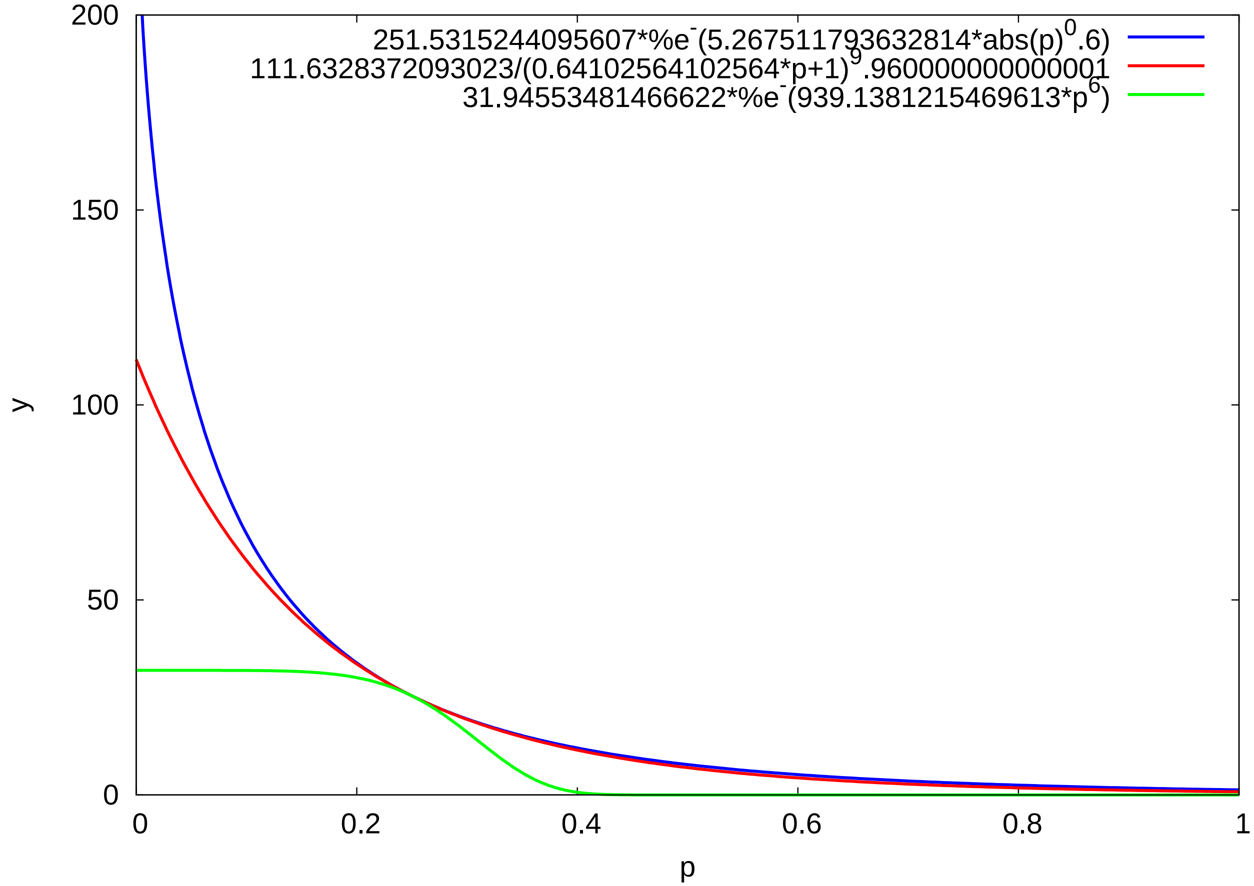
$$m_t = \sqrt{m_\pi^2 + p_t^2} \tag{6}$$

$$E\frac{d^3\sigma}{dp^3} = A(1 + p_t/p_{t0})^{-n} \text{ for } p_t > p_t^* \tag{7}$$

This exponential modification does not influence significantly to measured rapidity spectra and averaged p_t. Let's estimate, how more significant modification of low transverse momentum spectra influence on measured values.

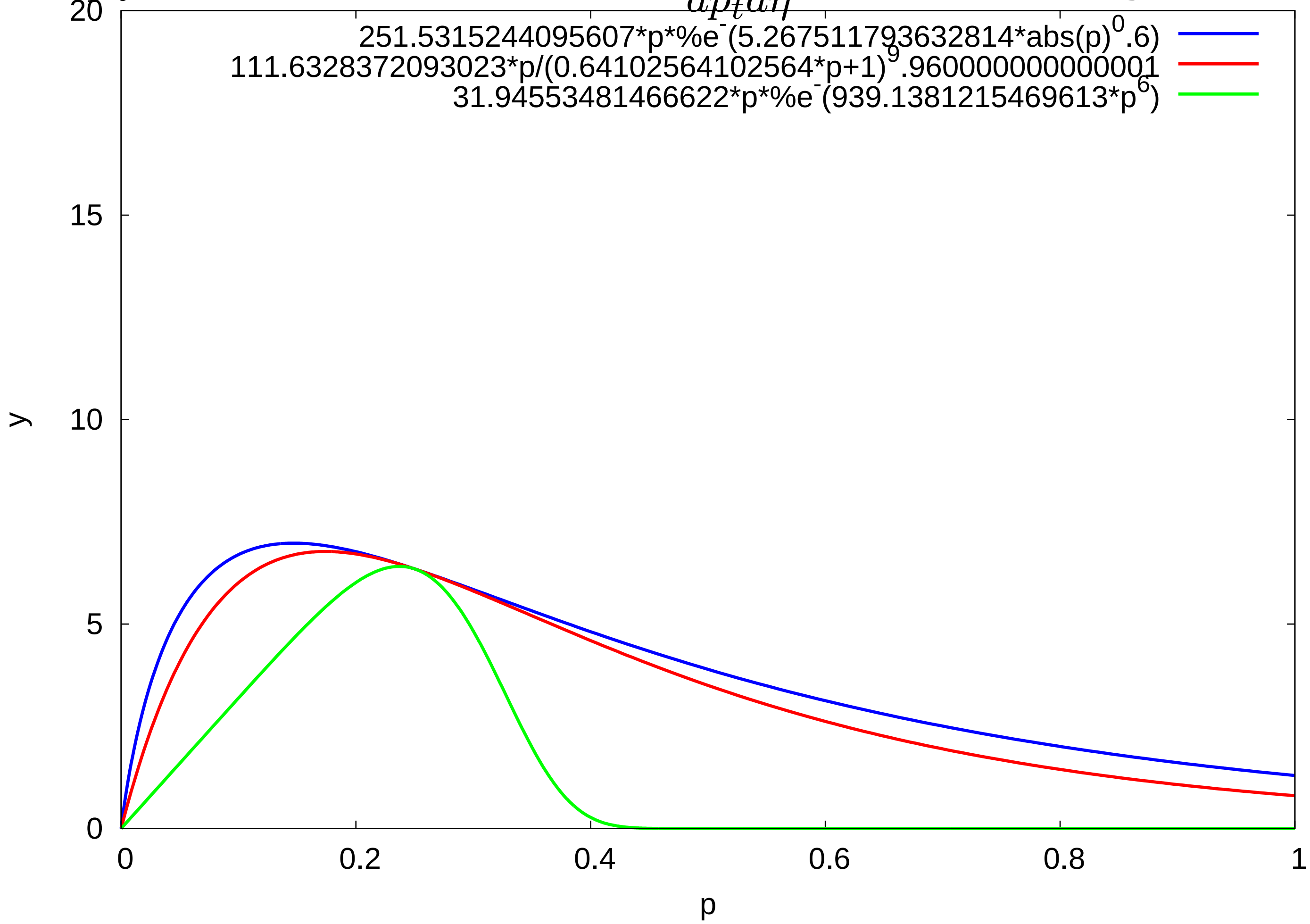
Highest hypotesys is motivated by generator simulations with peak around $p_t = 0$.

Lowest physically motivated hypotesys on behavior of spectra is that spectra $\frac{1}{p_t}\frac{dN}{dp_t}d\eta$ saturates at low pt, see lower curve on Fig.3.



251.5315244095607*%e^-(5.267511793632814*abs(p)^0.6)
111.6328372093023/(0.64102564102564*p+1)^9.960000000000001
31.94553481466622*%e^-(939.1381215469613*p^6)
200
150
100
50
0
y
0
0.2
0.4
0.6
0.8
1
p

Actually, difference is no so high, because of jacobian factor p_t, and estimations for $\frac{dN}{dp_t d\eta}$ shown at Fig.4



After integration one can get

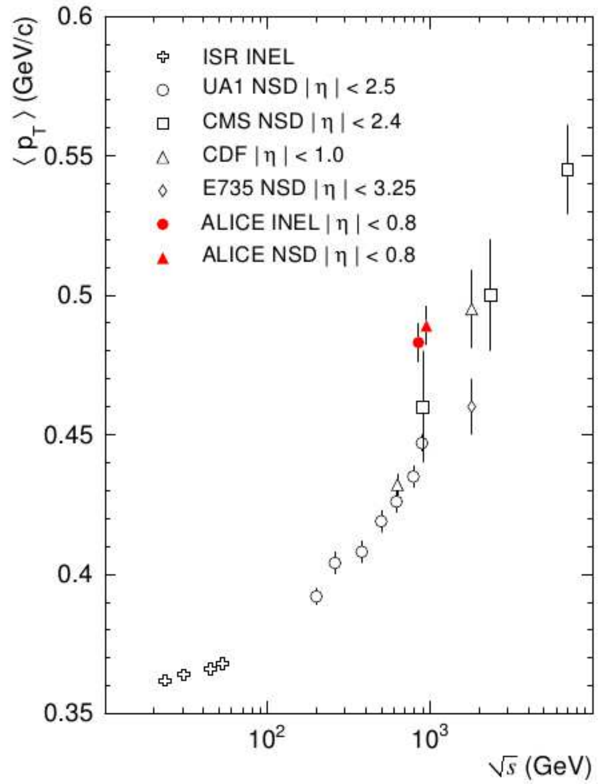
$$\text{low hypotesys} \quad \frac{dN}{d\eta} = 3.39 \quad < p_t >= 0.49 GeV \tag{8}$$

$$\text{actual data} \quad \frac{dN}{d\eta} = 3.8 \quad < p_t >= 0.448 GeV \tag{9}$$

$$\text{high hypotesys} \quad \frac{dN}{d\eta} = 3.94 \quad < p_t >= 0.436 GeV \tag{10}$$

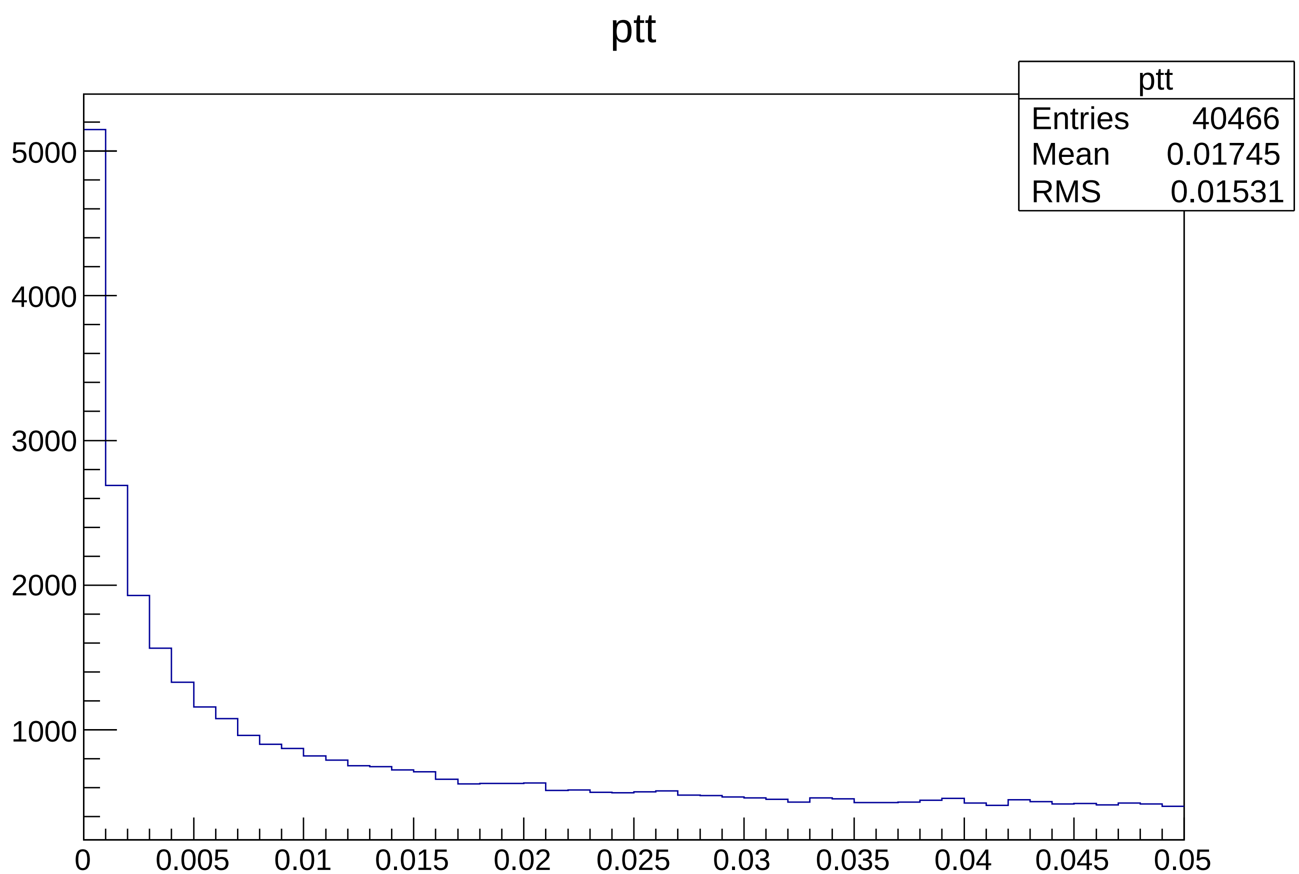
So, additional systematic uncertanity on rapidity spectra $\frac{dN}{d\eta}$ is estimated abot 15%, which makes rapidity spectra data compatable with transverse momenta spectra data.

Average momentum data range is compatable with our estimation of disparances too:



Conclusion

Equality of rapidity spectra for pp and $p\bar{p}$ is not surely stated, while $\frac{dN}{dp_t d\eta}$ is more generic one and clearly shows difference between pp and $p\bar{p}$ inclusive spectras.


ptt
ptt
Entries 40466
Mean 0.01745
RMS 0.01531
5000
4000
3000
2000
1000
0
0.005
0.01
0.015
0.02
0.025
0.03
0.035
0.04
0.045
0.05