D^0 cross section and R_{AA} in Isobar

2022.3.28

Bin centering scale factors

Levy func:

$$\frac{A(n-1)(n-2)}{nT(nT+m_0(n-2))} \times (1+\frac{m_T-m_0}{nT})^{-n}$$

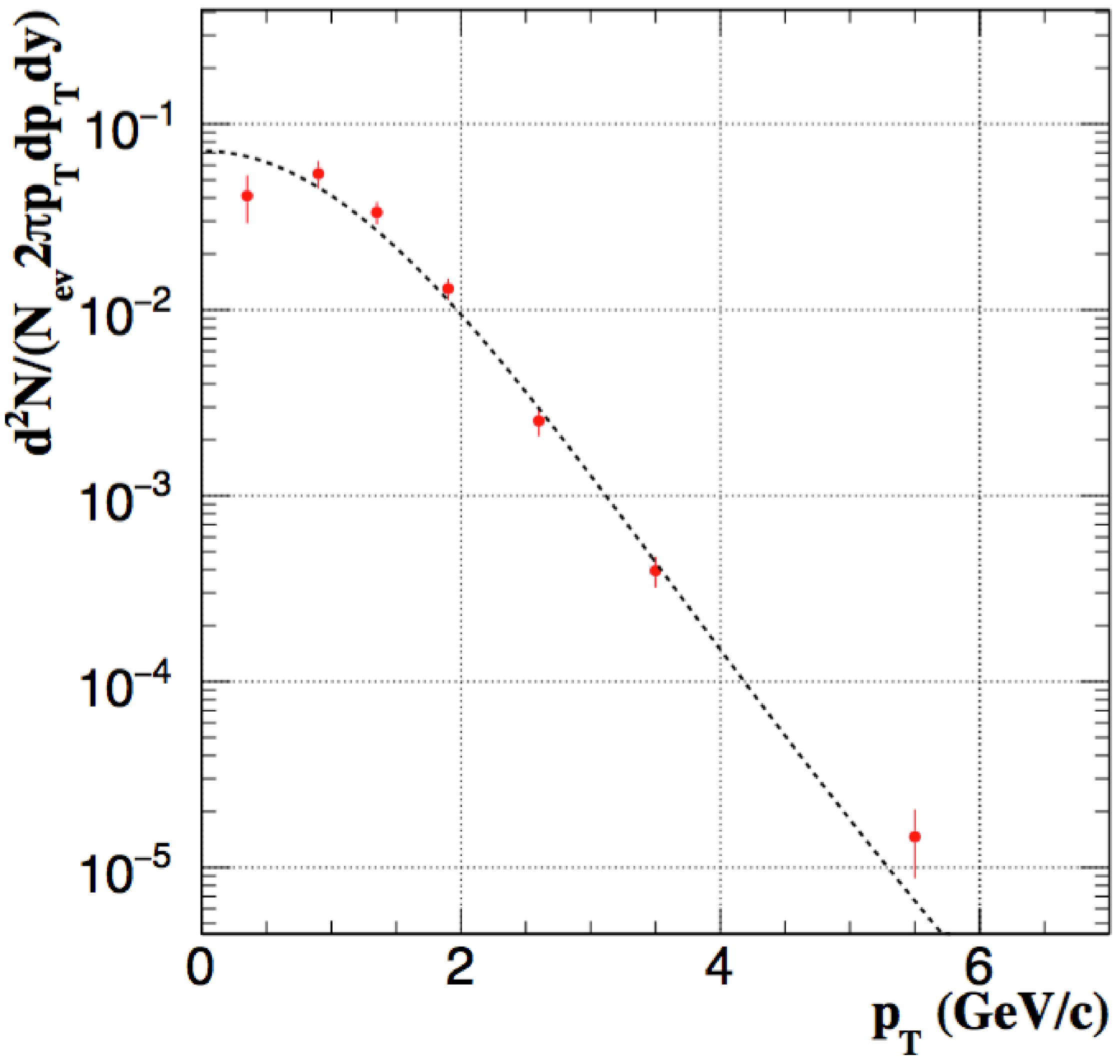
1. The measured yield, initially plotted at the bin centers, is approximated by Levy func;
2. To each bin a momentum p_T^* was assigned as calculated from the equation;

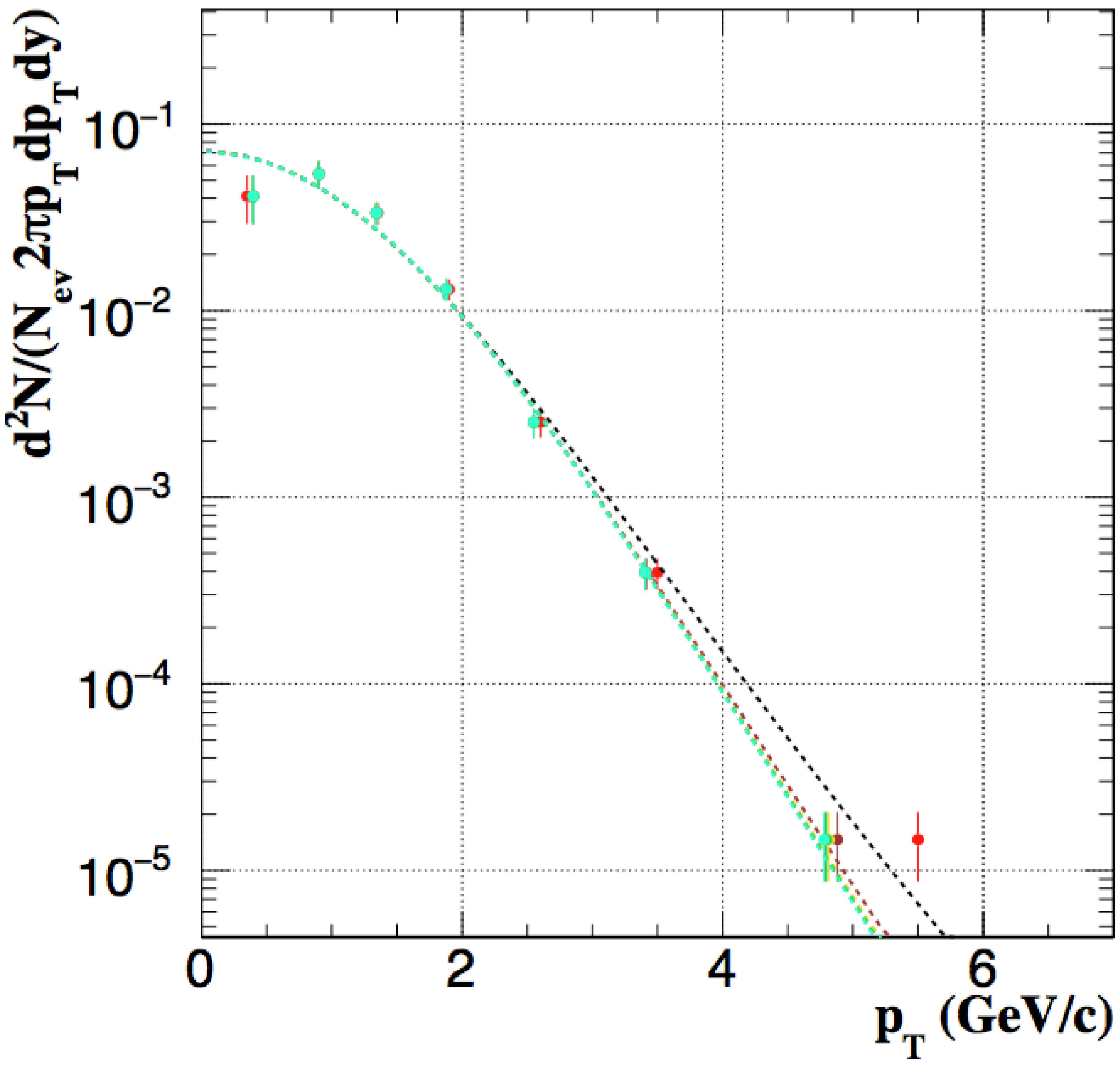
$$f(p_T^*) = \frac{1}{\Delta p_T}\int_{\Delta p_T} f(x)dx$$

3. Re-fitted p_T^* as the abscissa. This procedure was re-iterated until the values of p_T^* were stable.

Bin centering scale factors (RuRu)

0-10%

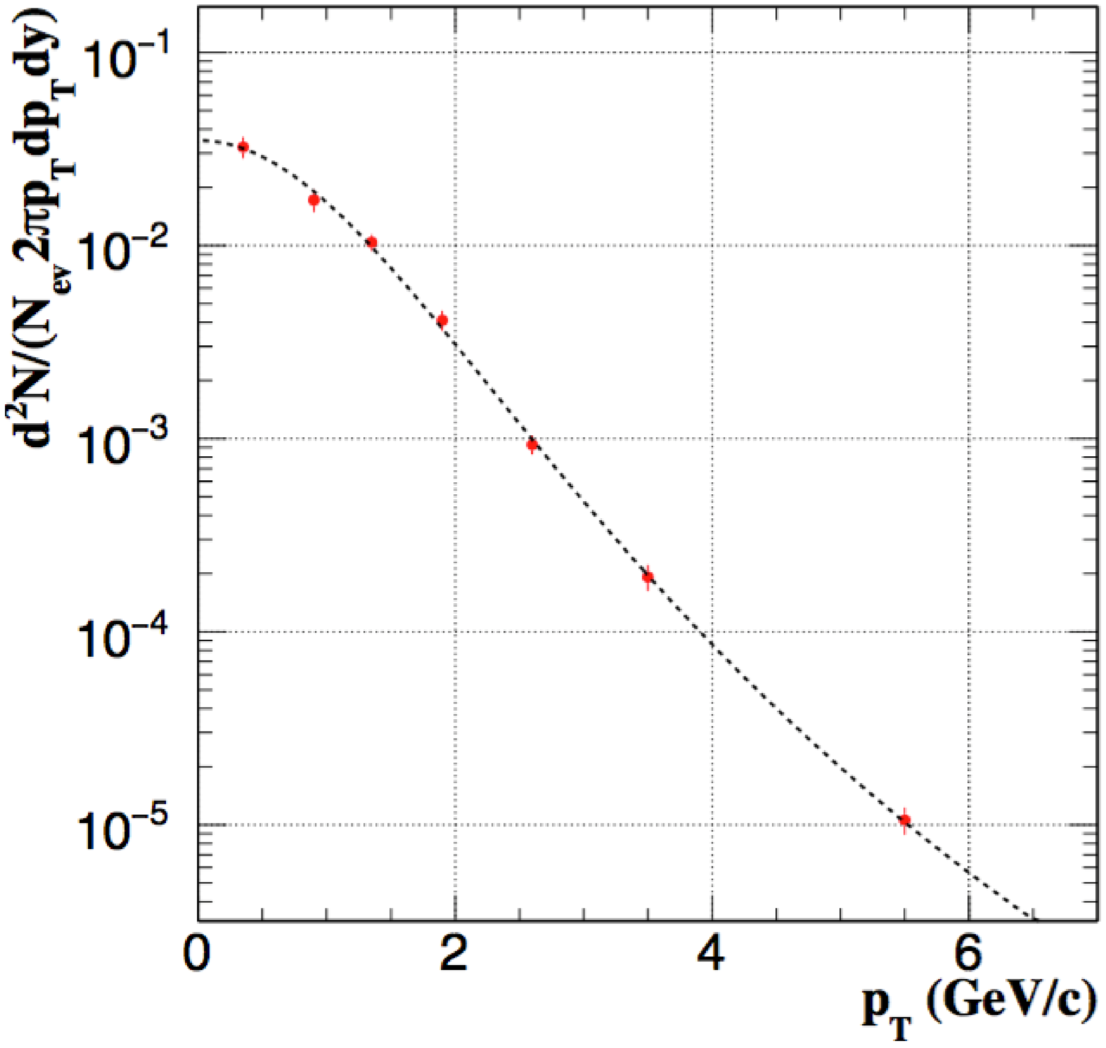


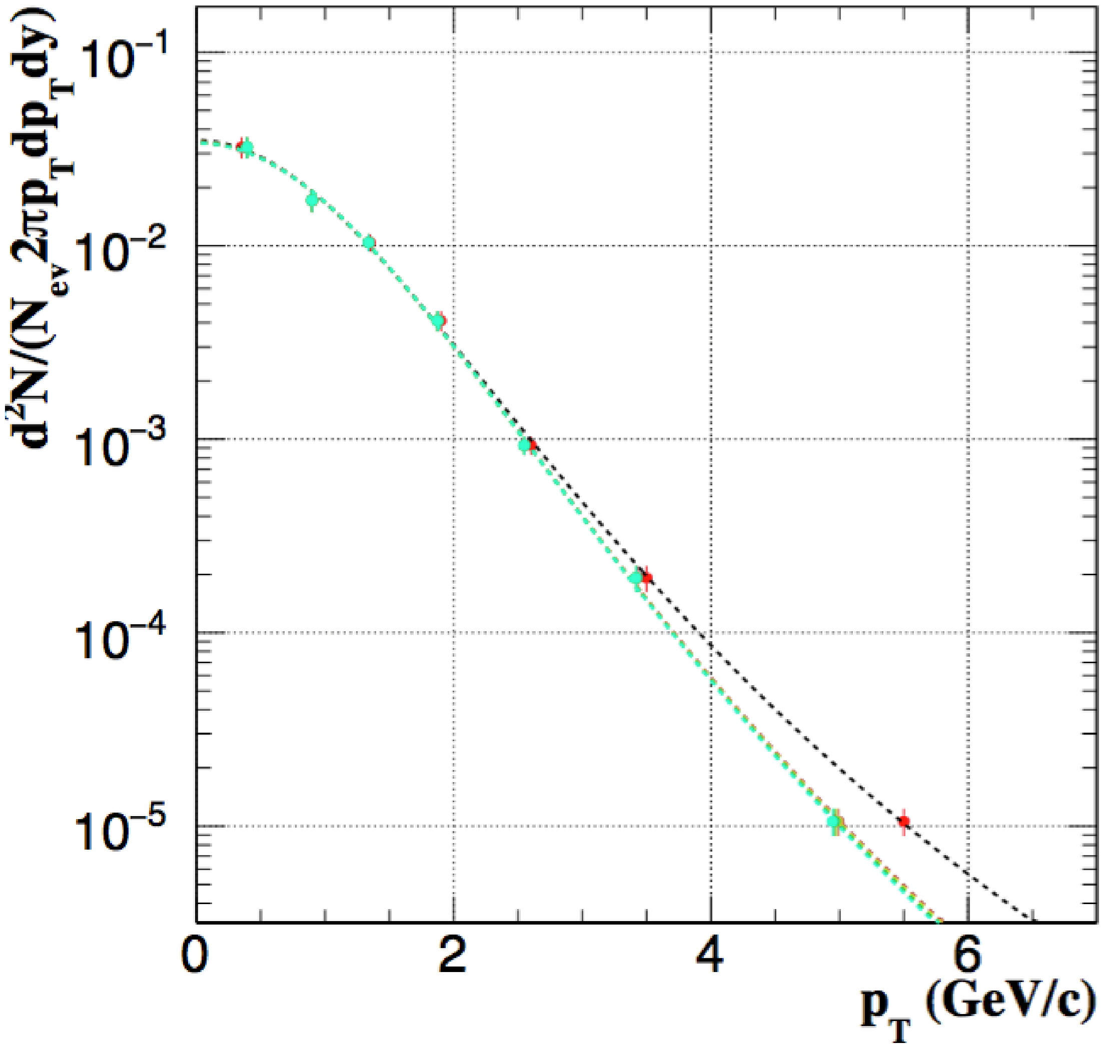


Narrow bin width will increase the precision.

Bin centering scale factors (RuRu)

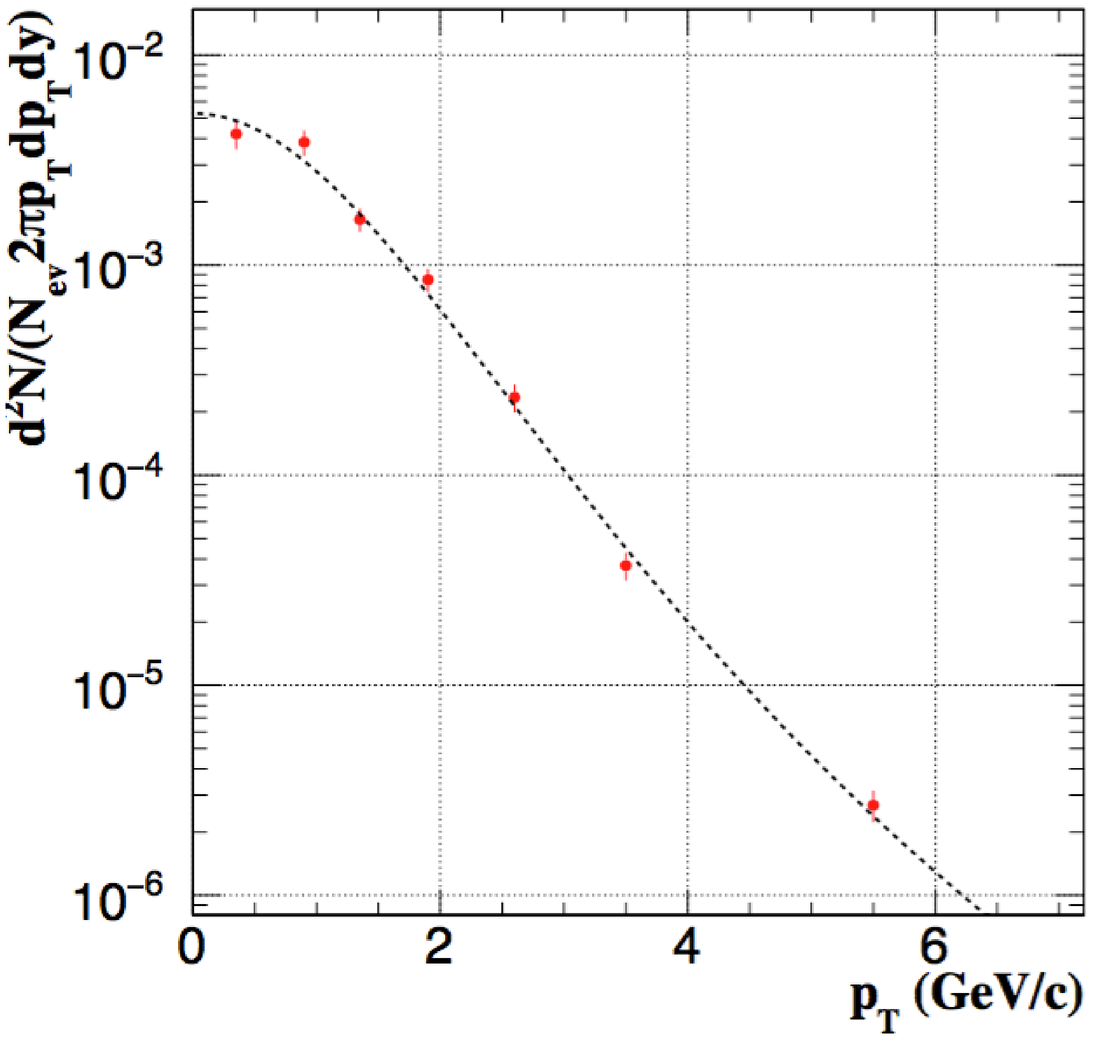
10-40%

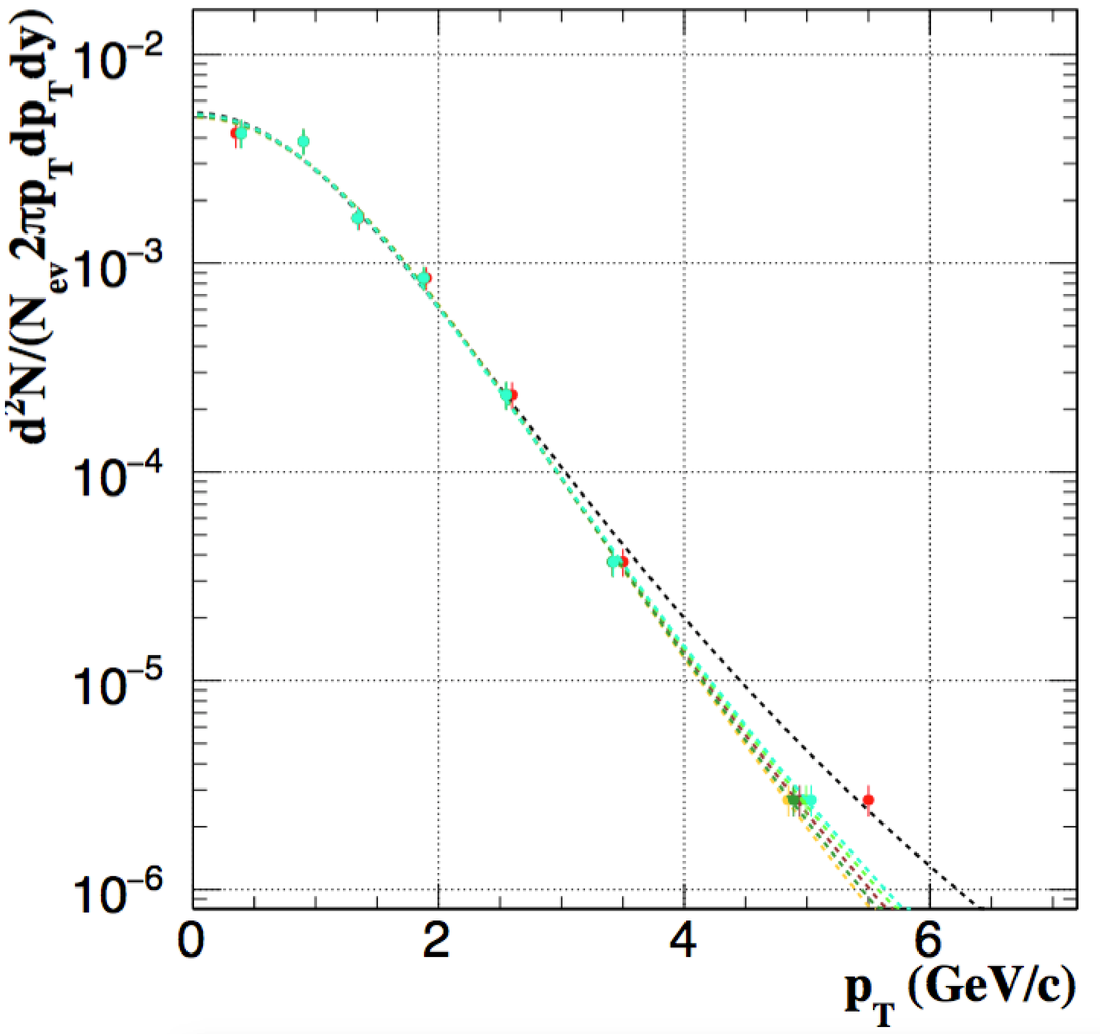




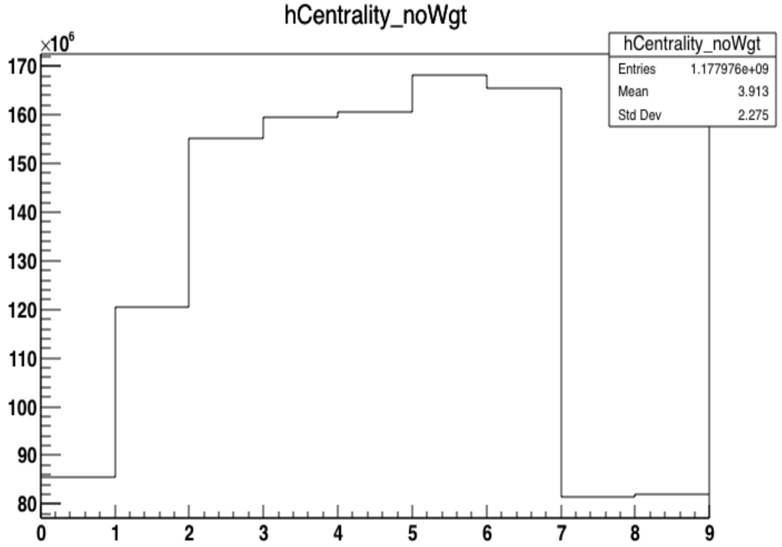
Bin centering scale factors (RuRu)

40-80%

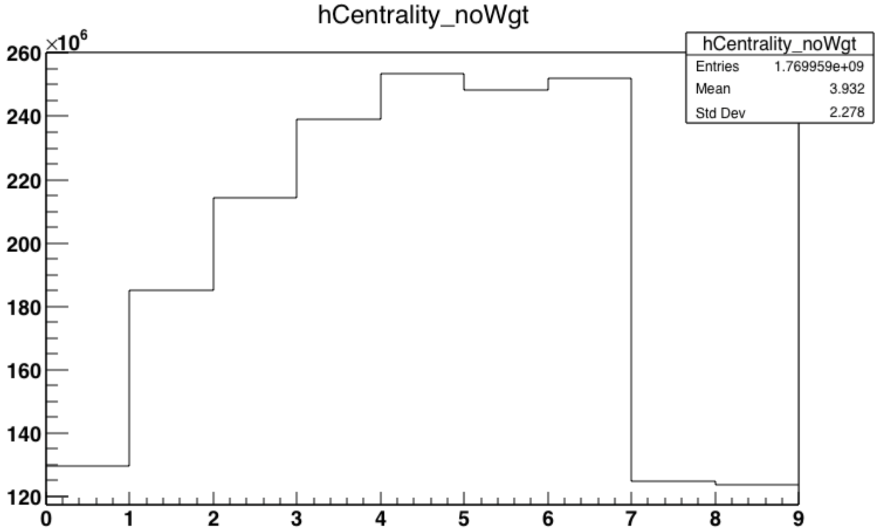




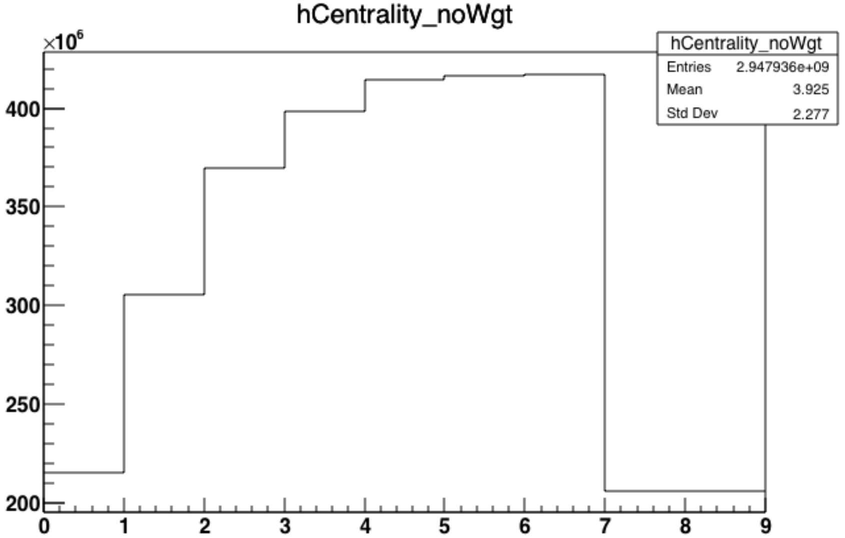
D^0 spectra in ZrZr & RuRu



0.2-7 GeV/c (RuRu)



0.2-8 GeV/c (ZrZr)



0.2-8 GeV/c (Isobar)

D^0 R_{AA}

Motivation:
As afunction of p_T: large p_T D^0 typically originate from hard processes, and then interact with dense and hot medium, lead to energy loss (R_{AA} probe) of the fast moving quark or gluon.

$$R_{AA} = \frac{d^2N_{AA}^{D^0}/dp_T dy}{< T_{AA} > d^2\sigma^{PP}/dp_T dy} = \frac{\sigma_{inel}^{NN} d^2N_{AA}^{D^0}/dp_T dy}{< N_{coll} > d^2\sigma^{PP}/dp_T dy}$$

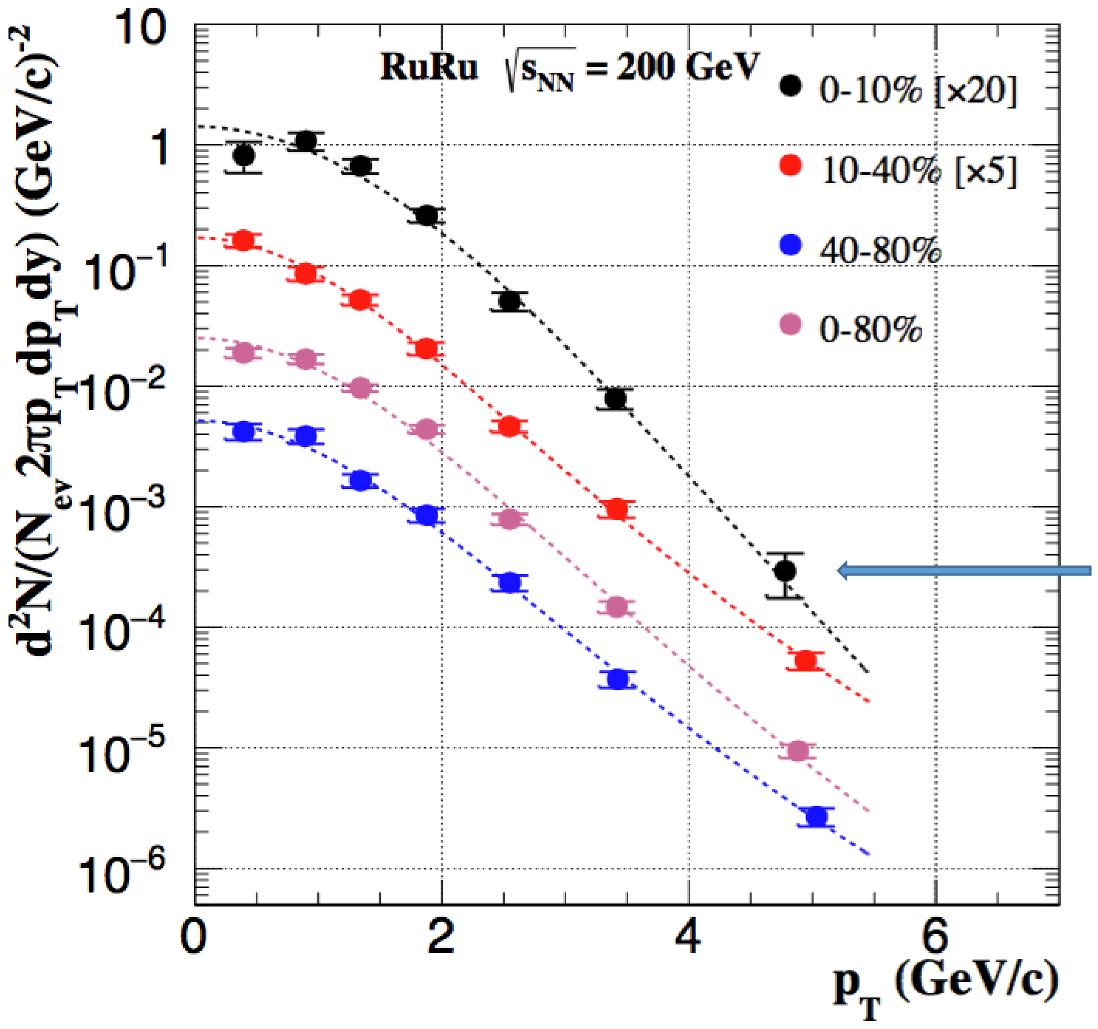
$$< T_{AA} > \times \sigma_{inel}^{NN} =< N_{coll} >$$ 42 mb

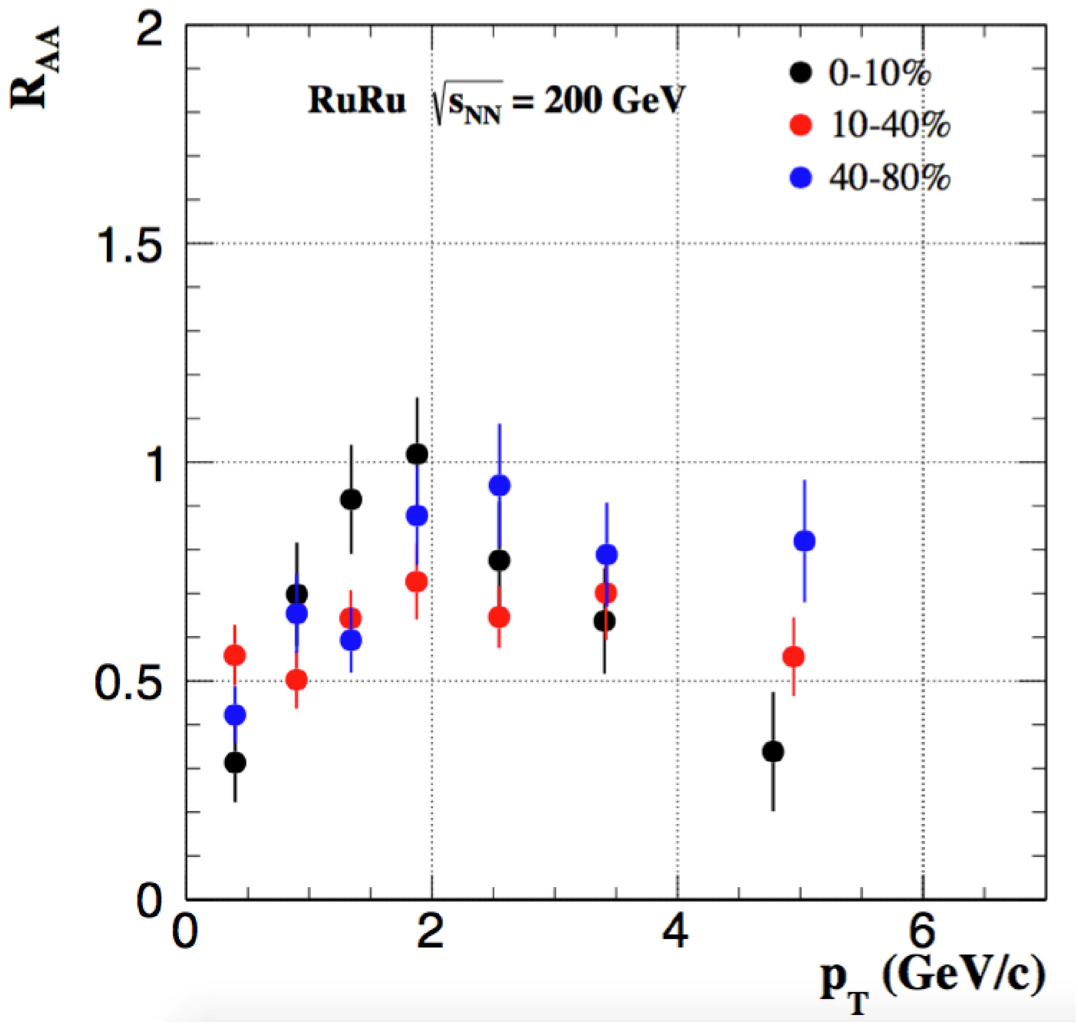
The yield (or number of particles per event) in Zr-Zr and pp collisions;

The number of pp collisions should be equivalent on average to one Zr-Zr collision (experiment & Glauber model)

$$R_{AA} = \frac{Y(\mathrm{ZrZr})}{< N_{coll} > Y(pp)}$$

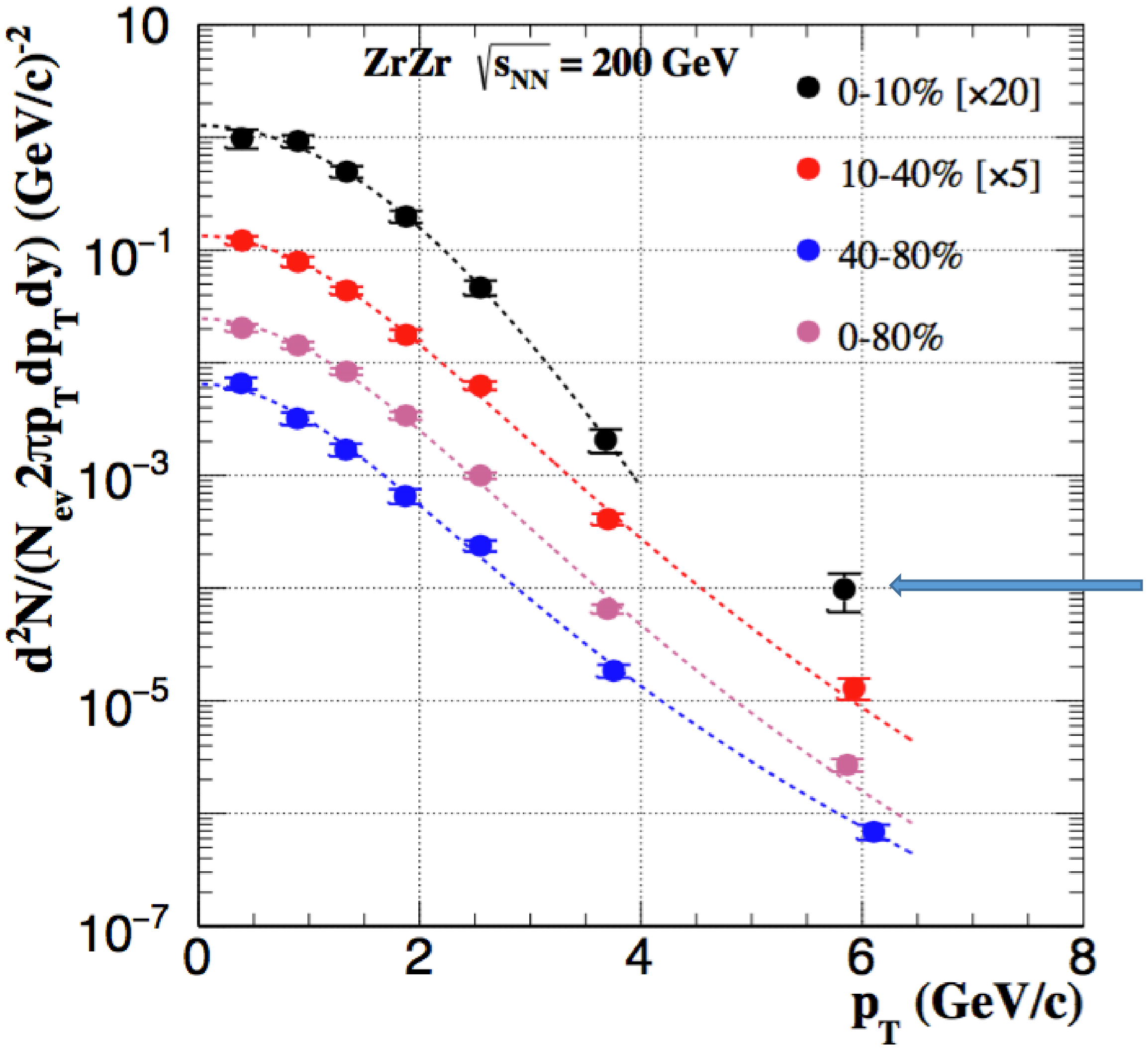
D^0 spectra in ZrZr & RuRu

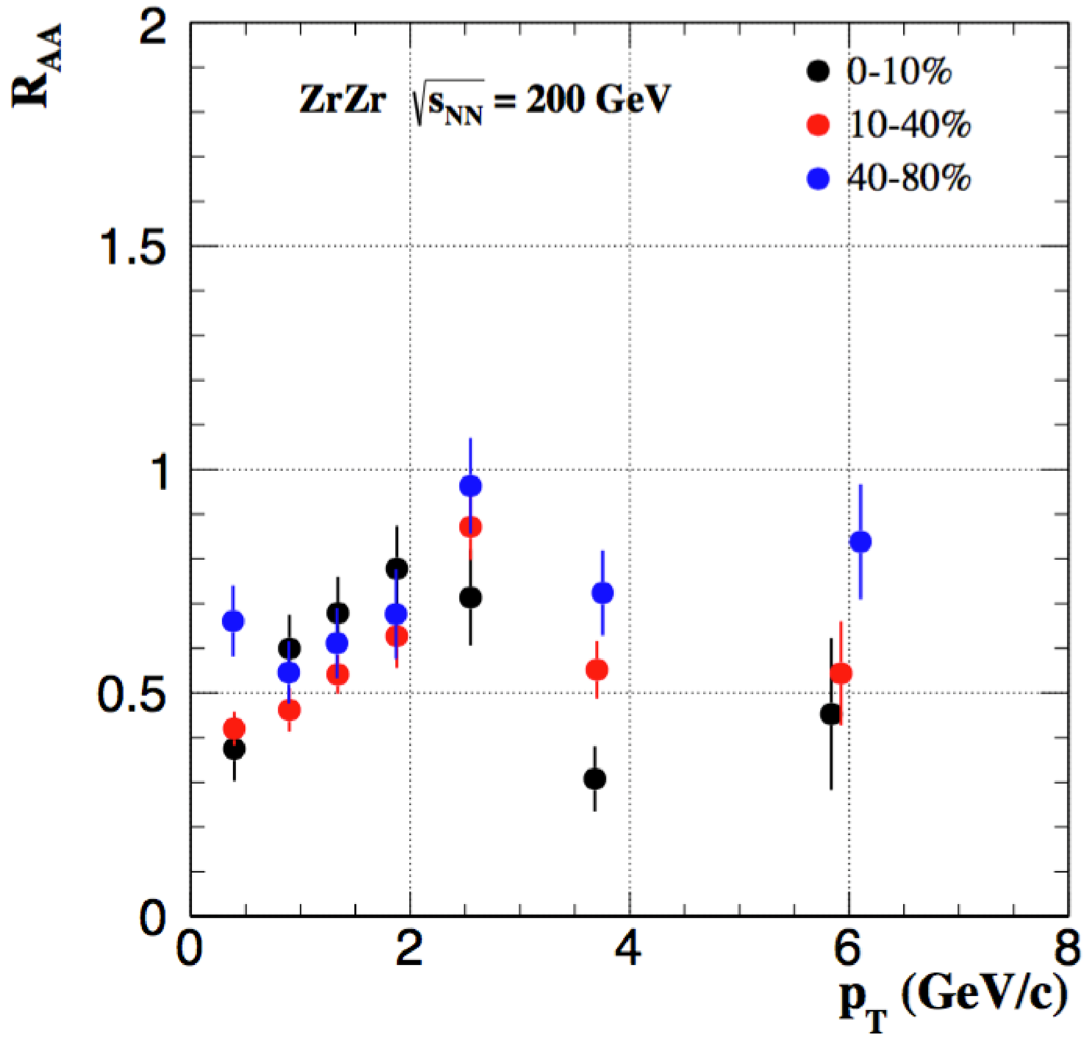




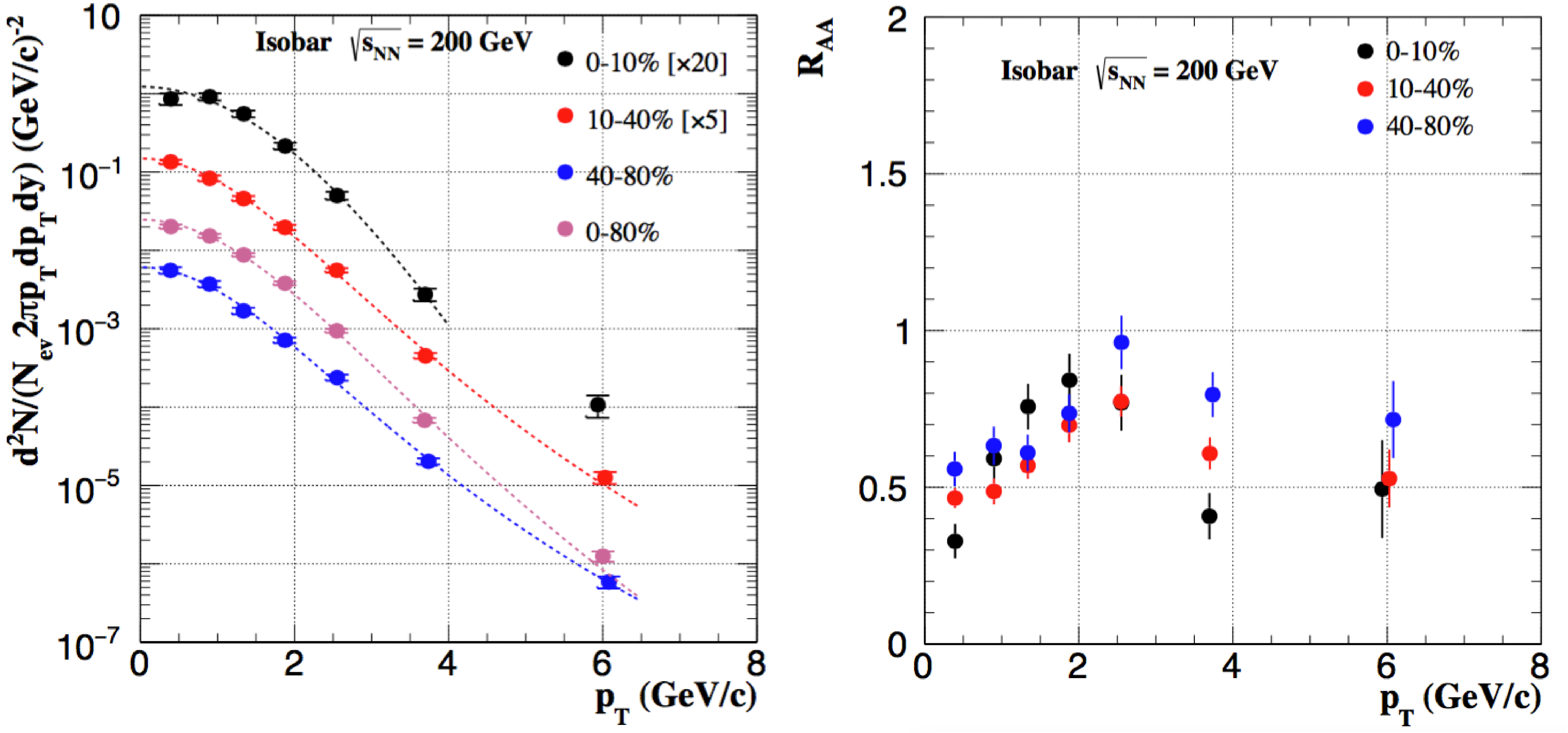
Strict Tofpid cut

D^0 spectra in ZrZr & RuRu

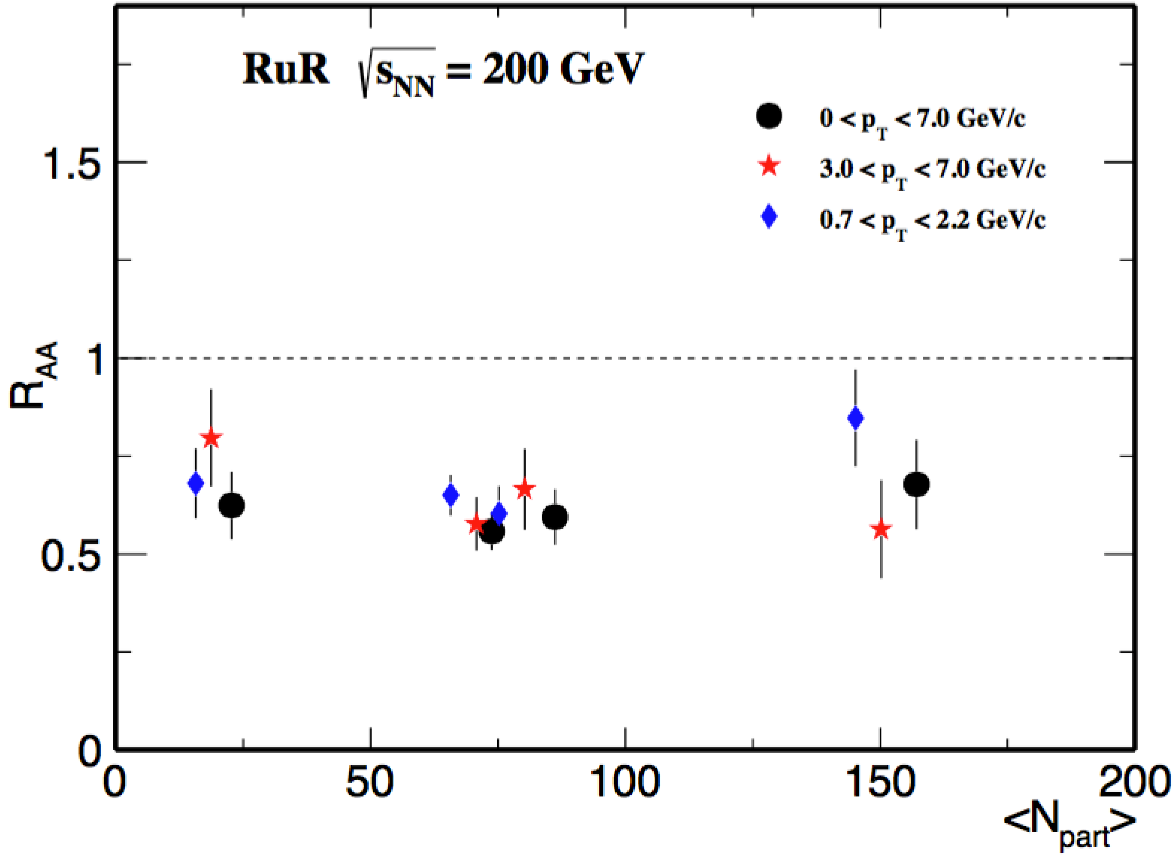


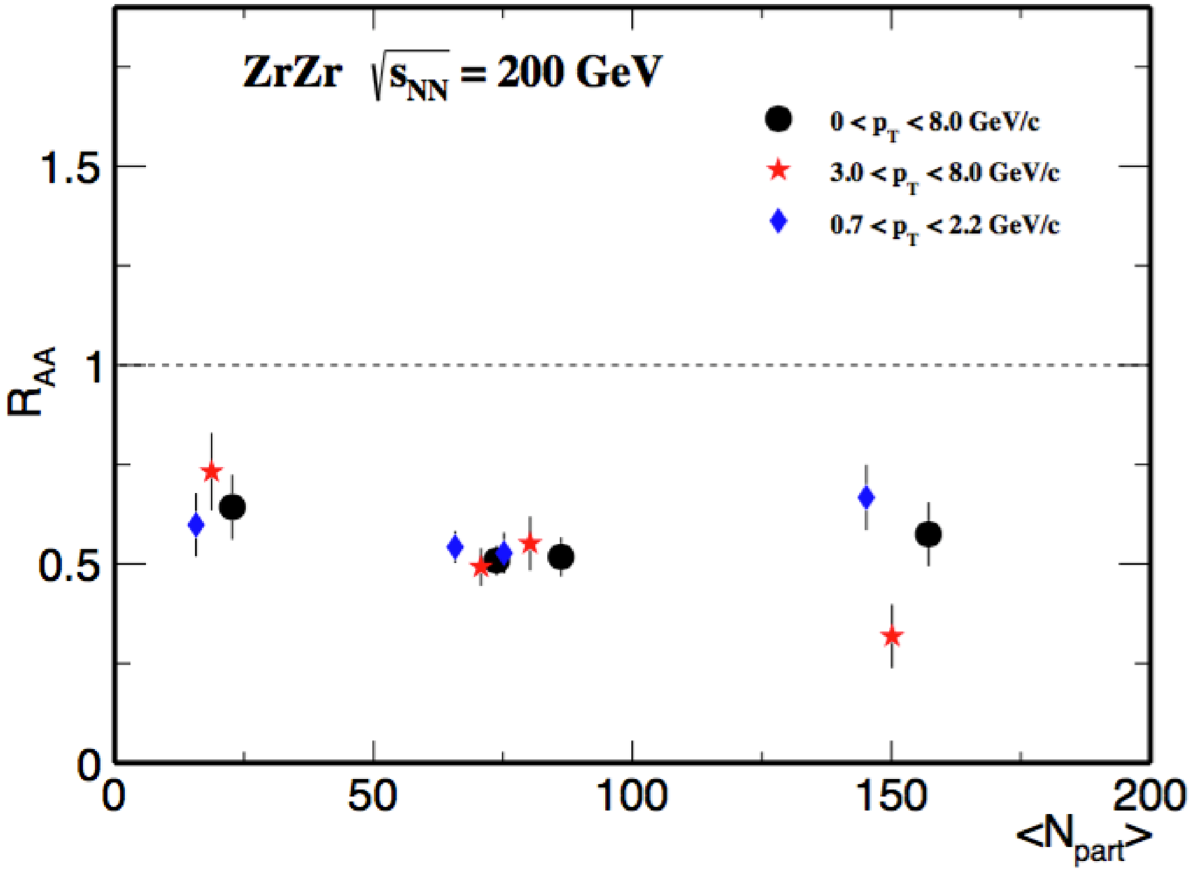


D^0 spectra in Isobar

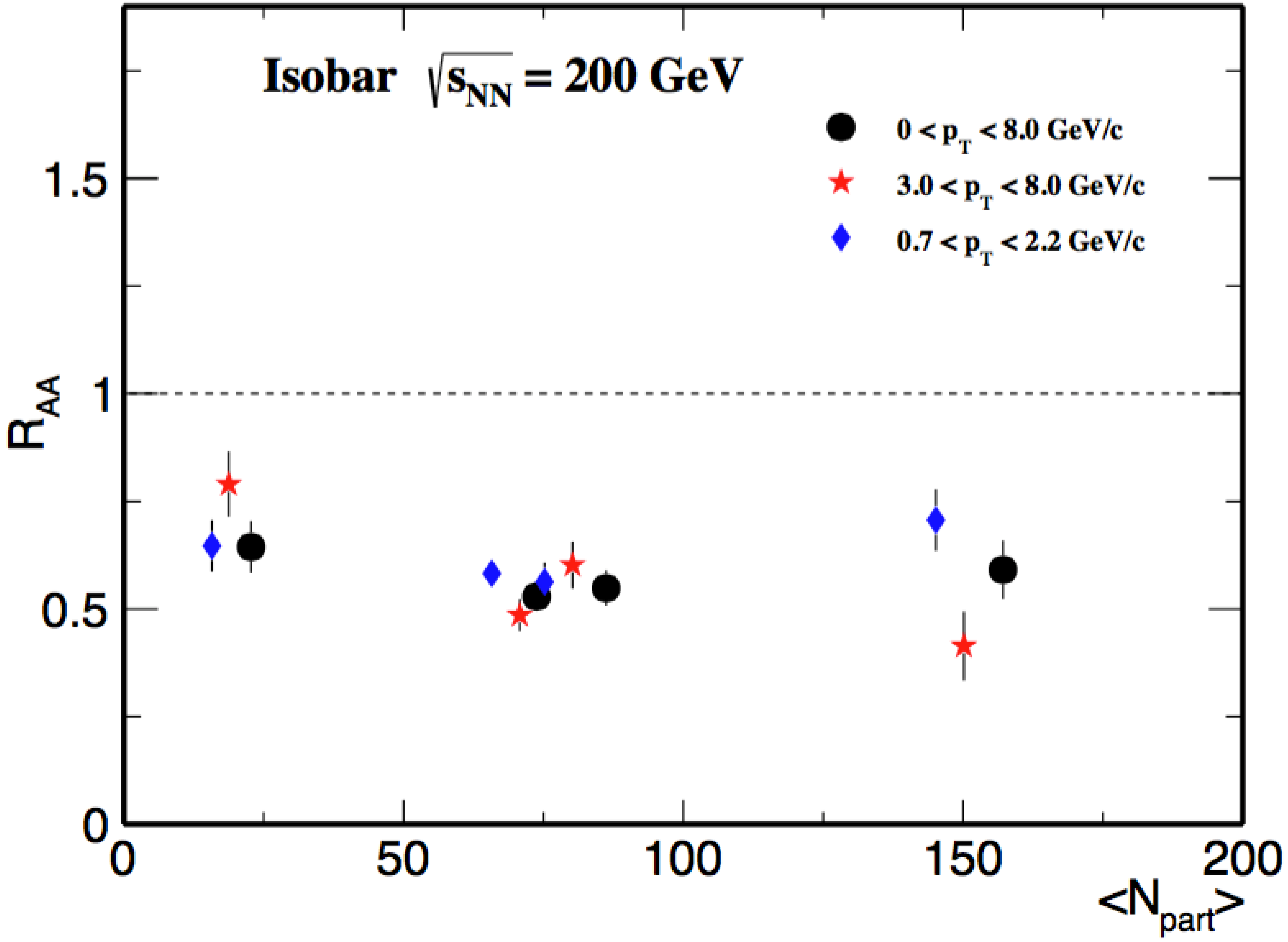


D^0 R_{AA} as a function of $<N_{part}>$





D^0 R_{AA} as a function of $<N_{part}>$



D^0 invariant yield and cross section

The invariant yield of D^0 per one minimum bias collision as a function of the transverse momentum:
(The Lorentz invariant differential single particle inclusive cross section)

$$E\frac{d^3N}{d\boldsymbol{p}^3} = \frac{d^3N}{p_T dp_T dy d\phi} = \frac{d^2N}{2\pi p_T dp_T dy}$$

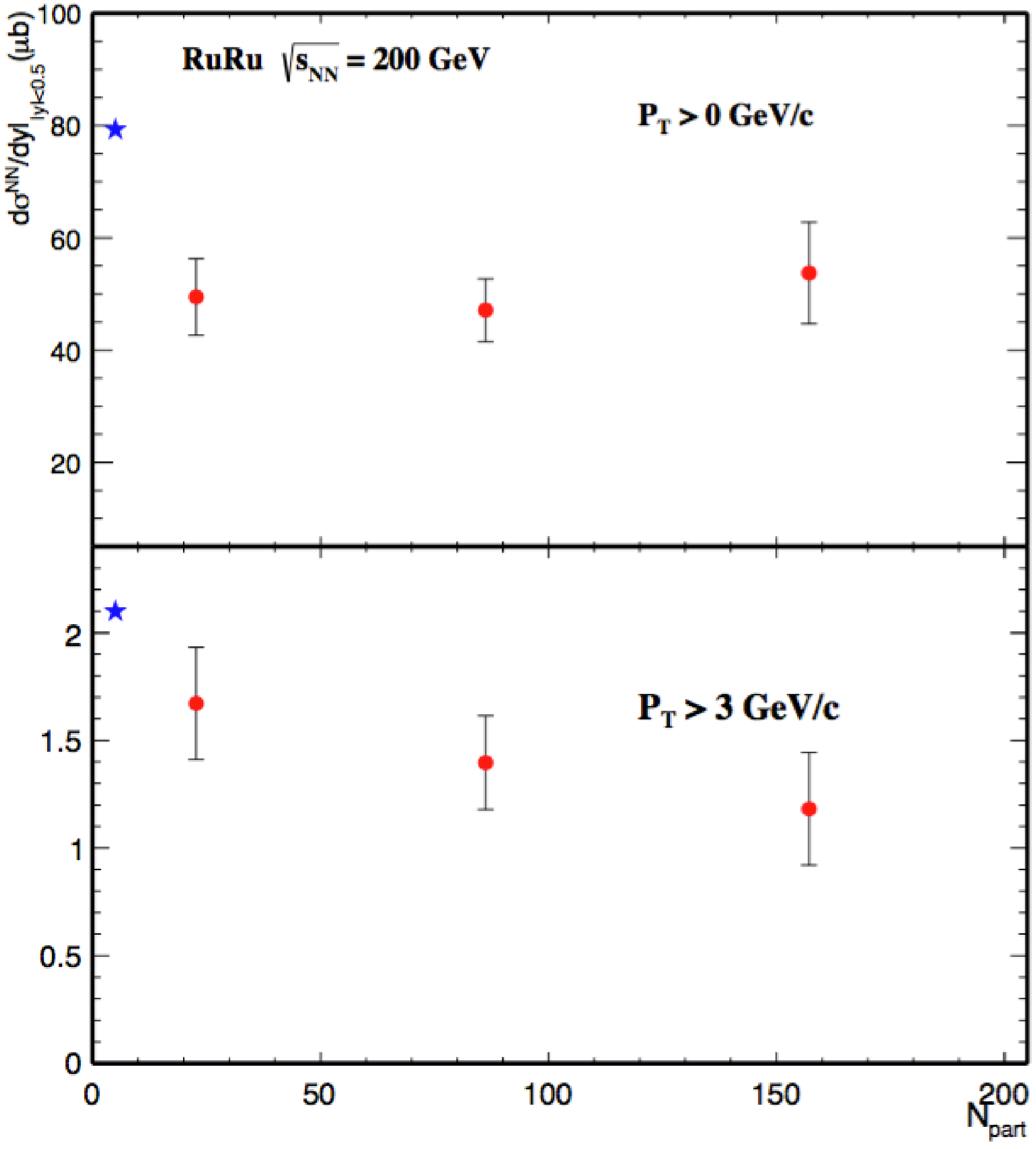
Φ uniform (check for D^0);
isotropic production in azimuth ~ Flow.

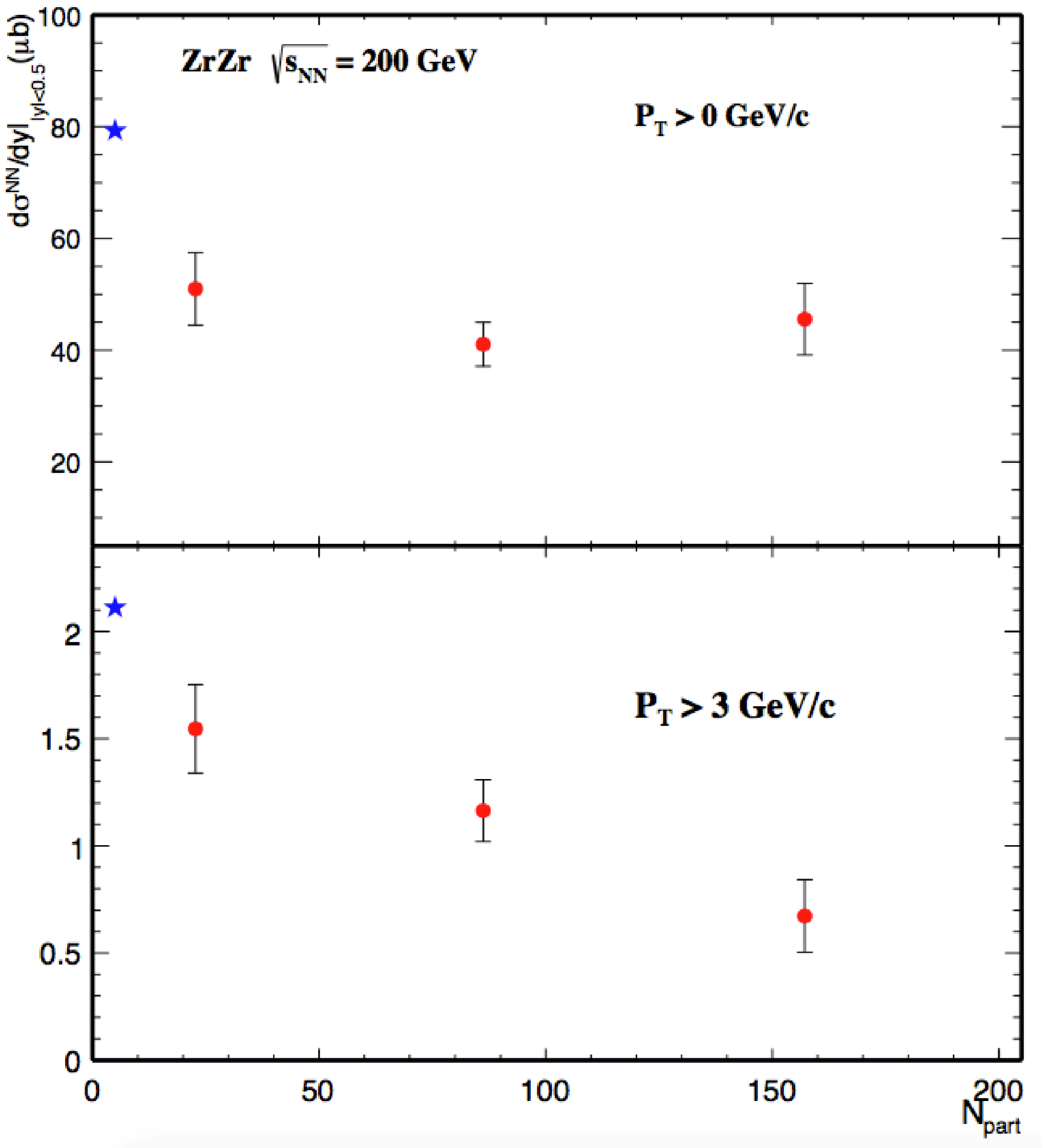
$$\frac{d^2\,N}{2\pi p_T dp_T dy} = \frac{\Delta N^{raw}/\epsilon_{D^0}^{tot}/2}{2\pi p_T \Delta p_T \Delta y \times N_{events} \times B.R.} = \frac{\Delta N_{D^0}^{AA}}{2\pi p_T \Delta p_T \Delta y} = E\frac{d^3\sigma_{D^0}^{AA}}{d\boldsymbol{p}^3}$$

$$\frac{dN_{D^0}^{AA}}{dy}|_{y=0} = \frac{\Delta N^{raw}/\epsilon_{D^0}^{tot}/2}{\Delta y \times N_{events} \times B.R.} \qquad \frac{d\sigma_{D^0}^{NN}}{dy}|_{y=0} = \frac{dN_{D^0}^{AA}}{dy}|_{y=0} \times \frac{\sigma_{inel}^{pp}}{< N_{bin} >}$$

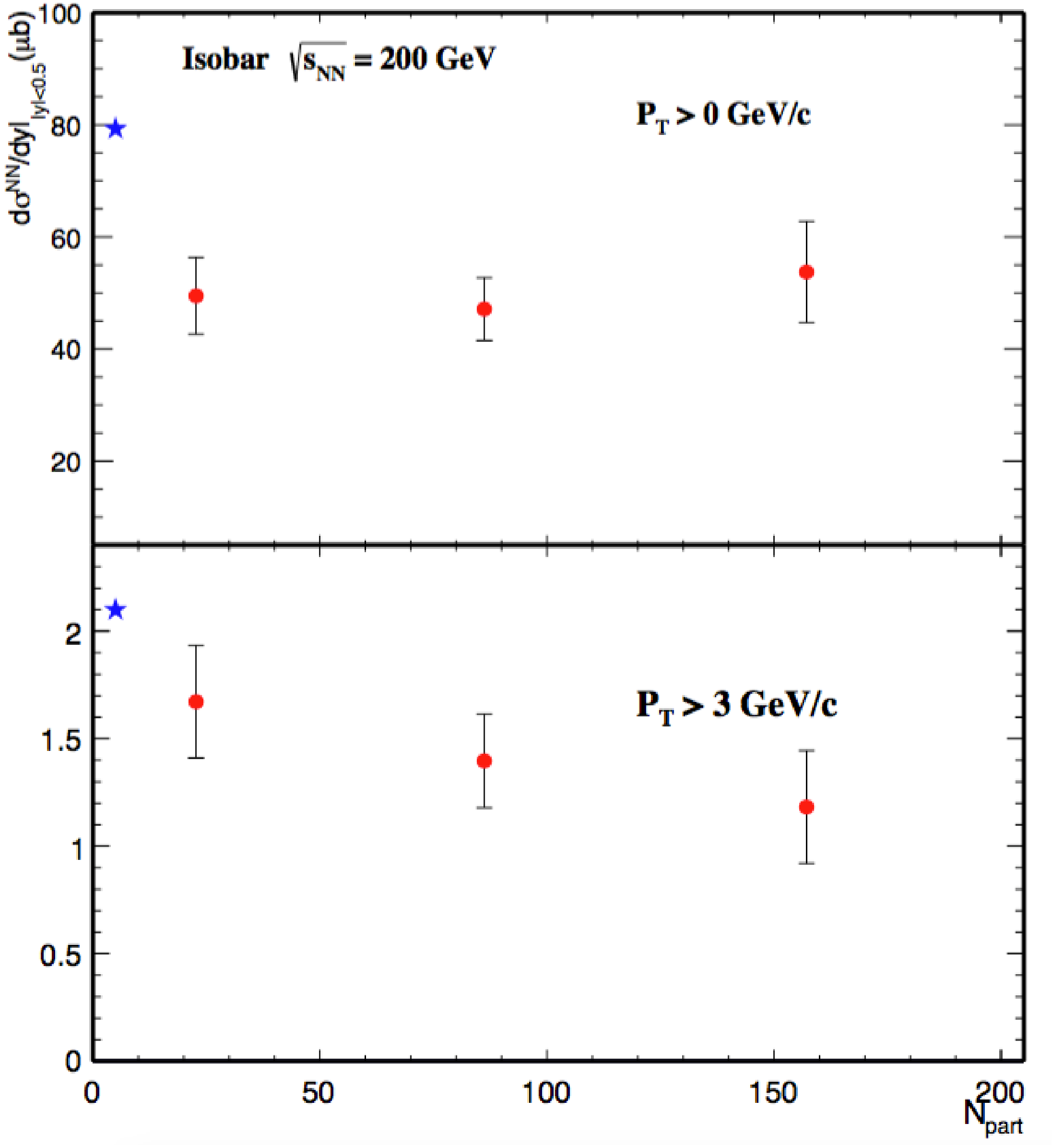
ΔN^{raw} is the raw yield measured in the bin $\Delta p_T \Delta y$;
Δp_T is the p_T bin for which the yield is calculated;
Δy is the rapidity range of the measurements, in this analysis Δy = 2; (check)
$B.R.$ is the branching ratio of the $K^-\pi^+$ decay channel。

D^0 cross section as a function of N_{part}





D^0 cross section as a function of N_{part}



Some issues should be considered for $p_T < 0.2$ GeV/c.

Strict checks

- Primary vtx efficiency;
- Double counting analysis;
- N_{coll} and N_{part} in a wide centrality bin;
- Mean and sigma setting for extracting raw yields;
- Loose cut and sys. Uncertainty.