Discussion session V: heavy ions (1)

Low-x Meeting 2015

Sandomierz, Poland

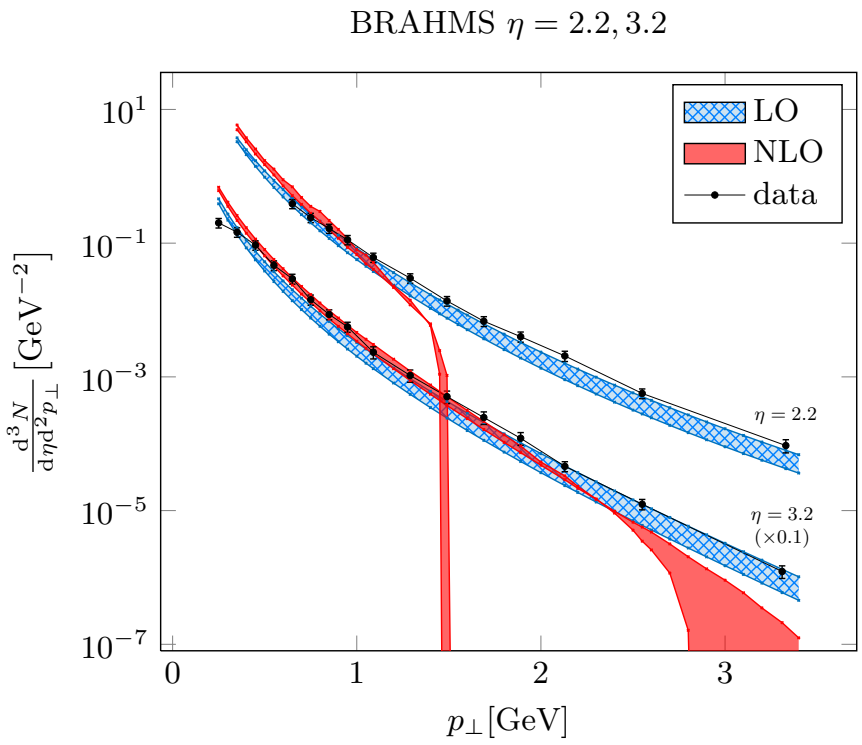
Single inclusive hadron production in pA scattering

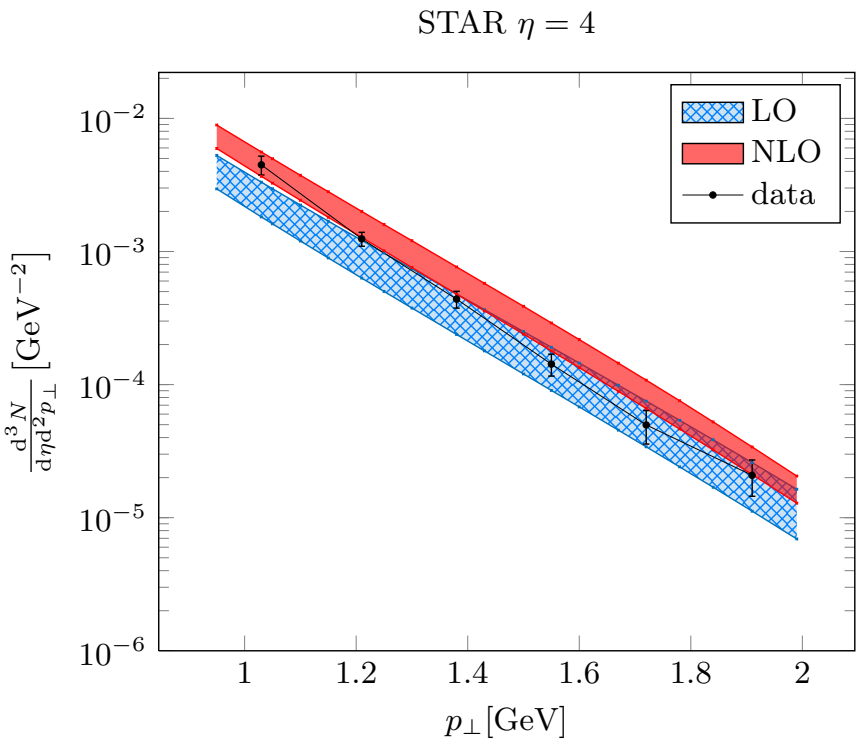
1. **"k_T-factorized" approach** : Kovchegov & Tuchin
   - Both the projectile and the target are at very small-x (very high energy)$\Rightarrow$ Color Glass Condensate (CGC) is applicable to both!

2. **"Hybrid" formalism** : Dumitru, Hayashigaki & Jalilian-Marian
   - The wave function of the projectile proton is treated in the spirit of collinear factorization (an assembly of patrons with zero intrinsic transverse momenta)
   - Perturbative corrections to this wave function are provided by the usual QCD perturbative splitting processes.
   - Target is treated as distribution of strong color fields which during the scattering event transfer transverse momentum to the propagating partonic configuration. (CGC like treatment)

Particle Production at NLO within "Hybrid" formalism

T. Altinoluk, A. Kovner - 2011 (Part of the NLO terms)
G.A. Chirilli, B.W. Xiao, F. Yuan - 2012 (Full NLO calculation)
A.M.Stasto, B.W.Xiao, D. Zaslavsky, - 2013 (Numerical Analysis at NLO)





Comparison of BRAHMS (h^-) and STAR (π^0) yields in dAu collisions to results of the numerical calculation with rcBK gluon distribution, both at LO and with NLO corrections included.

Revisiting the problem

T. Altinoluk, N. Armesto, G. Beuf, A. Kovner, M. Lublinsky - 2014
(Improved NLO calculation)

(1) What scatters? The Ioffe Time Restriction

The Ioffe Time Restriction provides a consistent description on what will be resolved by the target and what not!

- Only the pairs whose coherence time (Ioffe time) is greater than the propagation time through the target can be resolved by the target!
- Ioffe time is related with the size of the target at initial energy s_0.

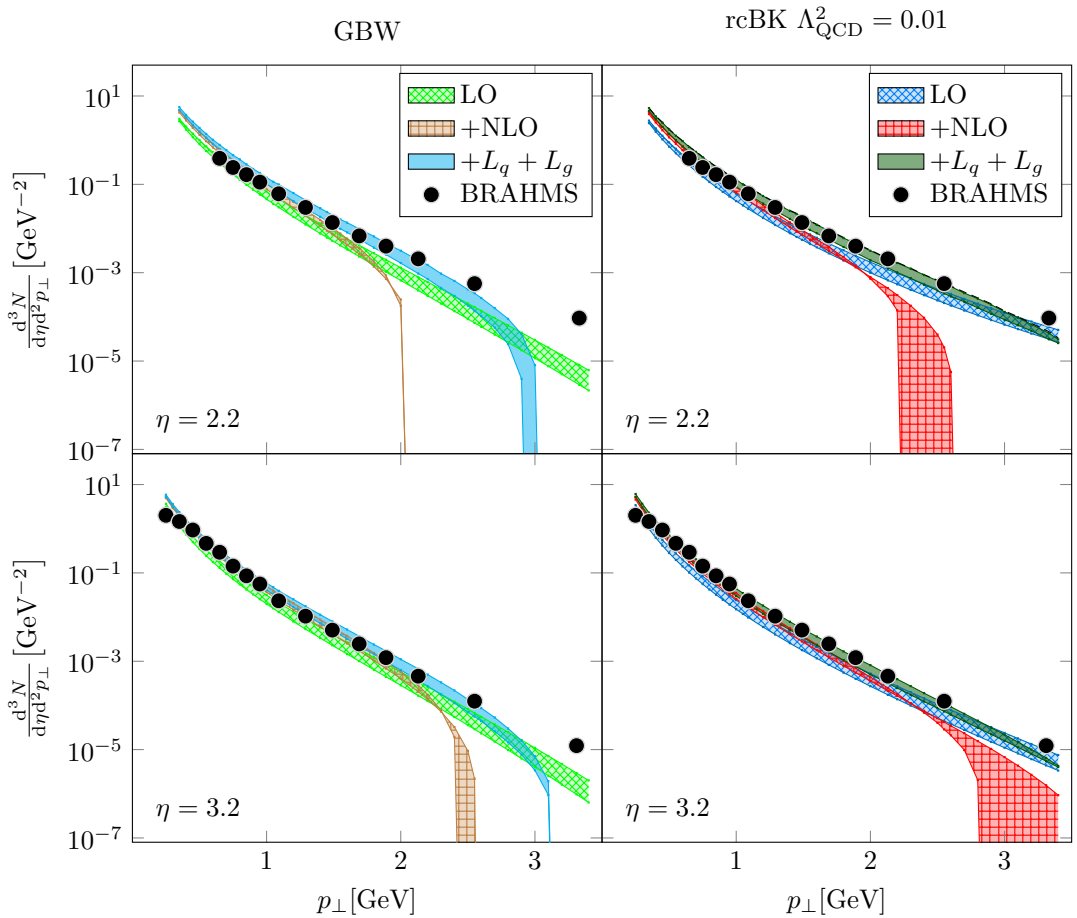
(2) The rapidity to which eikonal scattering amplitudes have to be evolved?

Y_T vs Y_g

- $Y_g = \ln \frac{1}{x_g}$ & $x_g = e^{-\eta} \frac{p_\perp}{\sqrt{2s}}$
  for a dense target projectile parton undergoes multiple scattering.
  the momentum transfer p^- is not from a single gluon but from several.
  x_g is an upper bound on the momentum fraction of the target gluon $\Rightarrow$ Y_g gives a lower bound on the rapidity up to which the target wave function has to be evolved!
- $Y_T = \ln \frac{s}{s_0}$ ✓

Revisiting the problem

K. Watanabe, B.W. Xiao, F. Yuan, D. Zaslavsky - 2015
(Numerical results for improved NLO)



Revisiting the problem

K. Watanabe, B.W. Xiao, F. Yuan, D. Zaslavsky - 2015
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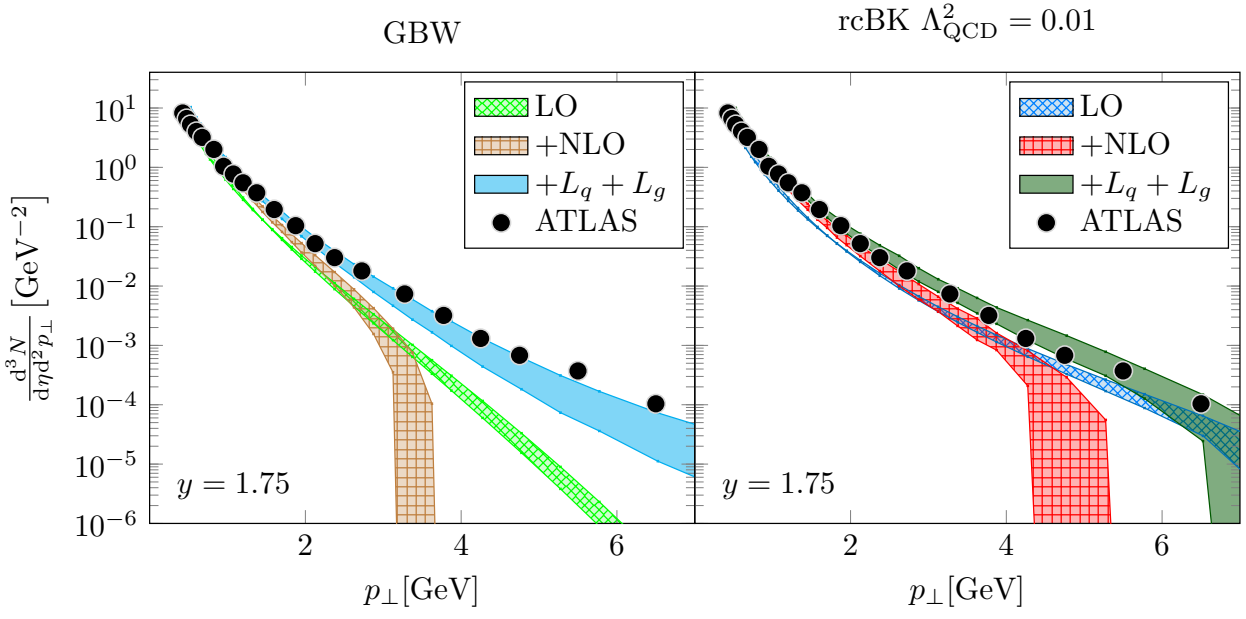

FIG. 6. Comparison of ATLAS forward-rapidity data [21] with the center-of-mass energy of $\sqrt{s_{NN}} = 5.02\,\mathrm{TeV}$ at $y = 1.75$ with SOLO results for the GBW and rcBK models. Again, the color scheme is the same as in figure 4. Here the error band shows plots for $\mu^2 = 10\,\mathrm{GeV}^2$ and $\mu^2 = 100\,\mathrm{GeV}^2$. Since the numerical data for these measurements are not published, we have extracted the ATLAS points from Fig. 6 of Ref. [21]. The extraction procedure introduces uncertainties comparable to the size of the points.

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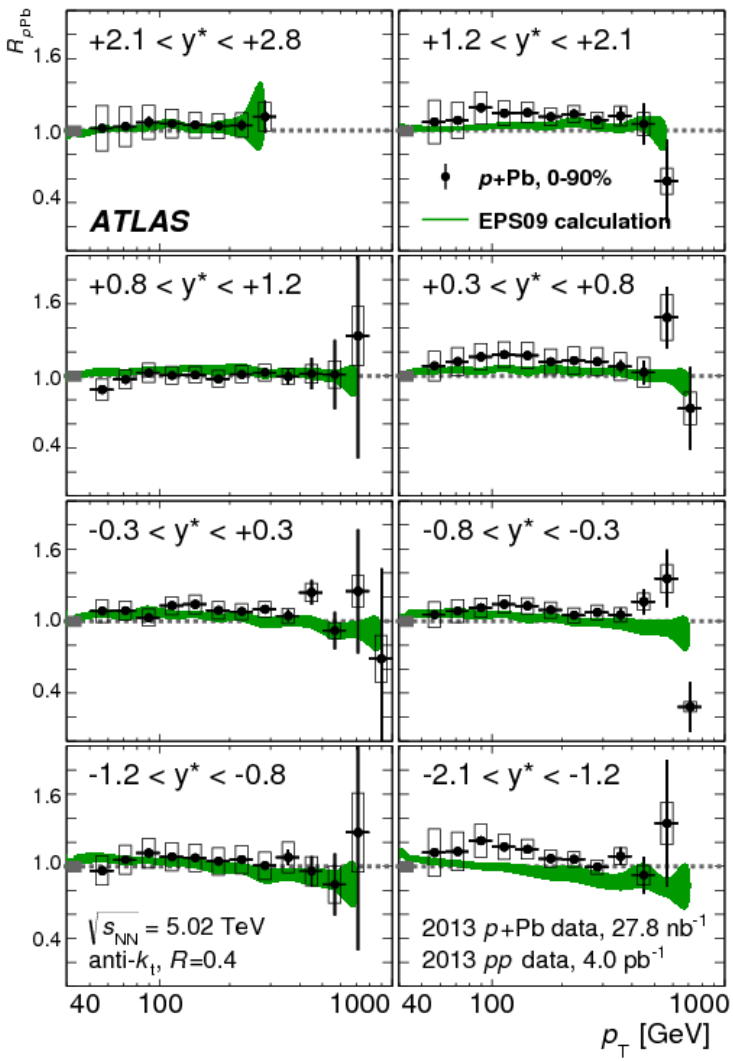
Centrality dependence of R_{pA}

$R_{p\mathrm{Pb}}$ for Inclusive Jets at LHC [ATLAS, Phys.Lett. B748 (2015) 392-413]



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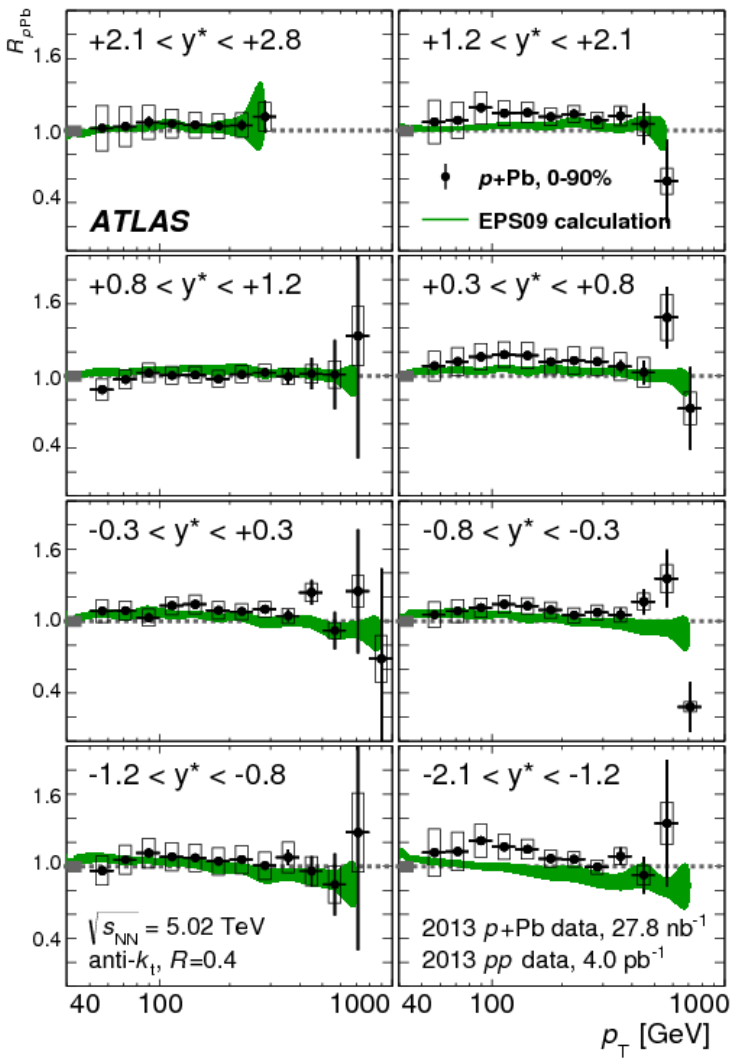

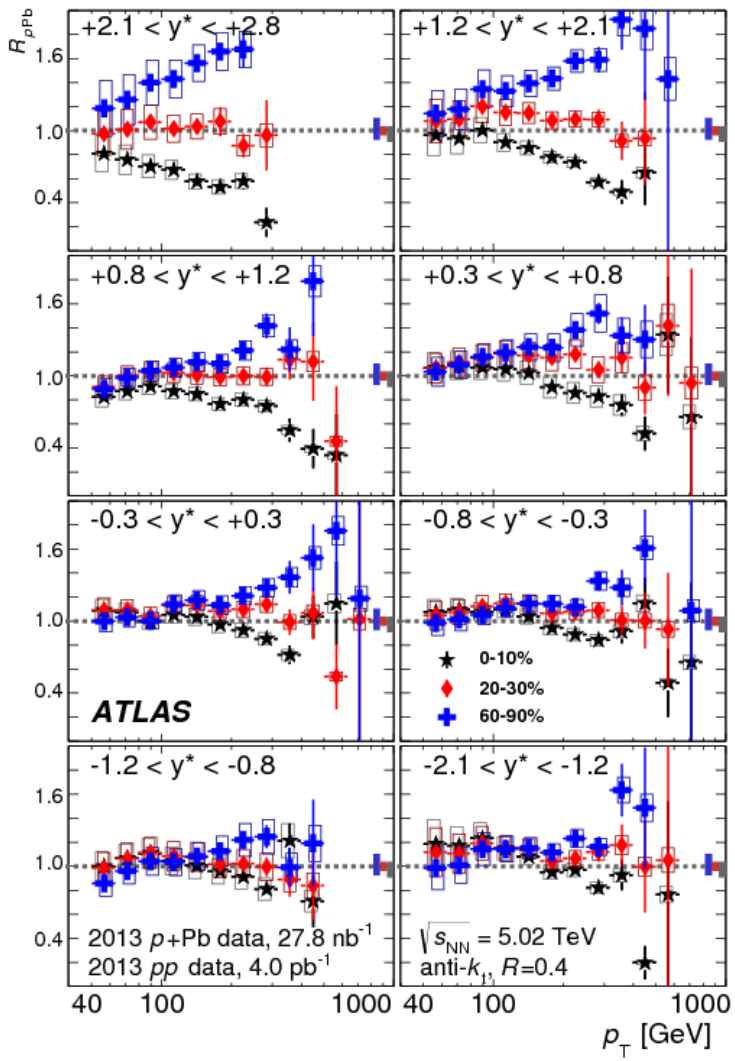

Centrality dependence of R_{pA}

Some explanations:

- suppression of soft emissions when an energetic jet is present
  [A. Bzdak, V. Skokov, S. Bathe; arXiv:1408.3156]
- reduction of an effective size (and thus the interaction cross section) of a configuration which contains large-x parton
  [M. Alvioli, B.A. Cole, L. Frankfurt, D.V. Perepelitsa, M. Strikman; arXiv:1409.7381]
- energy losses
  - [Z-B Kang, I. Vitev, H. Xing; arXiv:1507.05987]
  - [N. Armesto, D. Can Gülhan, J. G. Milhano; Phys.Lett. B747 (2015) 441-445]