Discussion session - Saturation

QCD at LHC: forward physics and UPC collisions of heavy ions, Trento, Italy

September 26-30, 2016
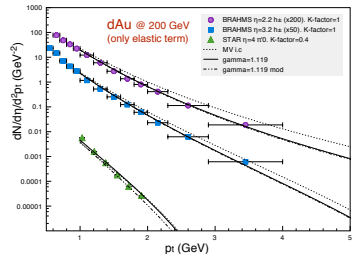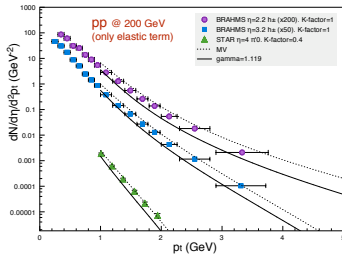
Forward inclusive hadron production at LO

Hybrid factorization at LO in pA - (Dumitru, Hayashigaki, Jalilian-Marian - 2006)

- Dilute projectile is treated in the spirit of the collinear factorization.
- Dense target is treated in the CGC framework.

$$\frac{\mathrm{d}^3\sigma^{pA\rightarrow hX}}{\mathrm{d}y_h\mathrm{d}^2\vec{p}_\perp} = \int_\tau^1 \frac{\mathrm{d}z}{z^2}\left[\sum_f x_p q_f\left(x_p\right)\mathcal{F}_{x_g}(k_\perp)D_{h/f}\left(z\right) + x_p g\left(x_p\right)\tilde{\mathcal{F}}_{x_g}(k_\perp)D_{h/f}\left(z\right)\right]$$
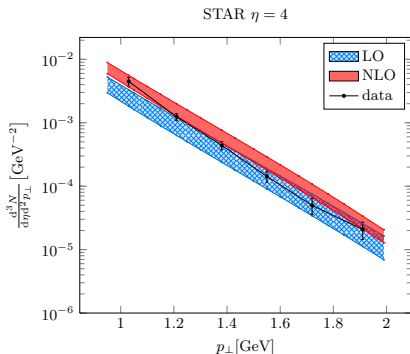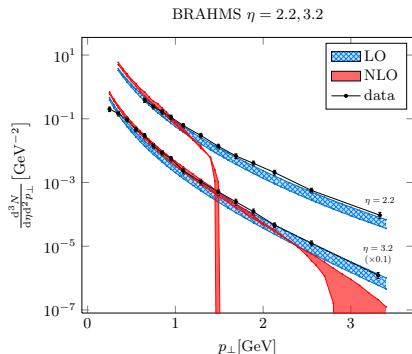
Albacete, Dumitru, Fujii, Nara (2013):

NLO expressions contain divergences that have to be regulated properly to have a finite result. (Altinoluk, Kovner (2011) + Chrilli, Xiao, Yuan (2012))

- ▶ Rapidity divergences incorporated by BK of the target
- ▶ Initial and final state collinear divergences incorporated by DGLAP of the PDFs and FFs.

However,

Several attempts to isolate and fix the problem. . .

Stasto, Yuan, Xiao, Zaslavsky (2014)
Altinoluk, Armesto, G.B., Lublinsky, Kovner (2015)
Watanabe, Yuan, Xiao, Zaslavsky (2015)
Ducloue, Lappi, Zhu (2016)
Iancu, Mueller, Triantafyllopoulos (2016)

Even though they differ in details, the main ingredient in these attempts are:
(i) Consistent regularization of the rapidity divergence.
(ii) Using Ioffe time restriction or exact kinematics to match the collinear calculation.
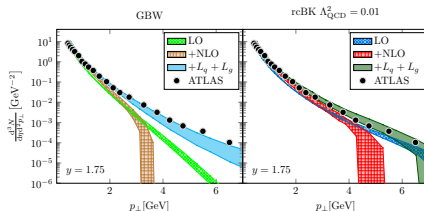New numerical analysis (Watanabe, Yuan, Xiao, Zaslavsky (2015)):

FIG. 6. Comparison of ATLAS forward-rapidity data [21] with the center-of-mass energy of $\sqrt{s_{NN}} = 5.02$ 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.