

Monte-Carlo Event Generator for CGC: What has to be done?

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Deng, et al. ArXiv:hep-ph1410.2018,
Albasete, et.al ArXiv:hep-ph1605.08334

- Introduction
- Event generator version of DHJ formula
- To do list
- Summary

Gluon production based on CGC

- **x-evolution + Solving classical Yang-Mills equation**

CYM + IP-sat model, Schenke, Tribedy, Venugopalan

CYM+JIMWLK evolution, Lappi, Phys.Lett.B703(2011)325,
B.Schenke,.Schlichting, PRC94(2016)

- **rcBK evolution + Based on kt-factorization formula**

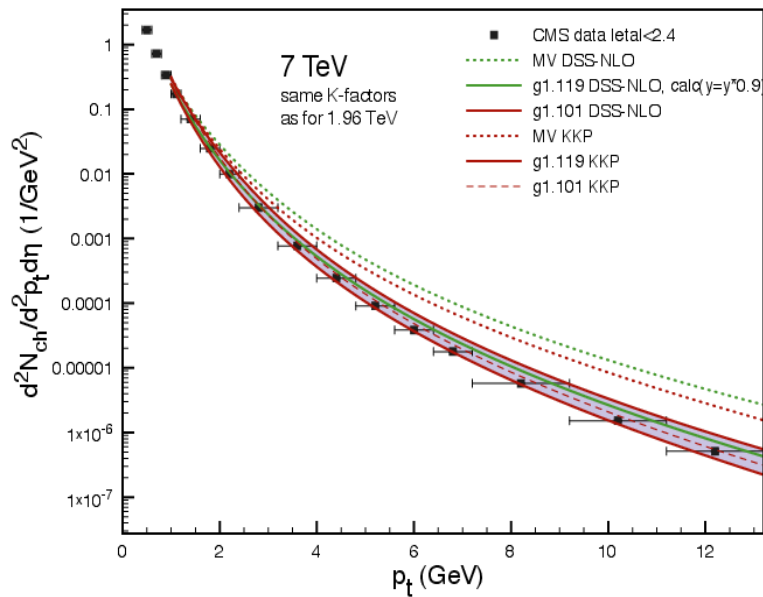
$$\frac{dN_g}{d^2 x_t dy} = \frac{4\pi N_c}{N_c^2 - 1} \int \frac{d^2 p_t}{p_t^2} \int d^2 k_t \alpha_s \phi(x_1, k_t^2) \phi(x_2, (p_t - k_t)^2)$$

Forward particle production: Dumitru Hayashigaki Jalilian-Marian (DHJ)

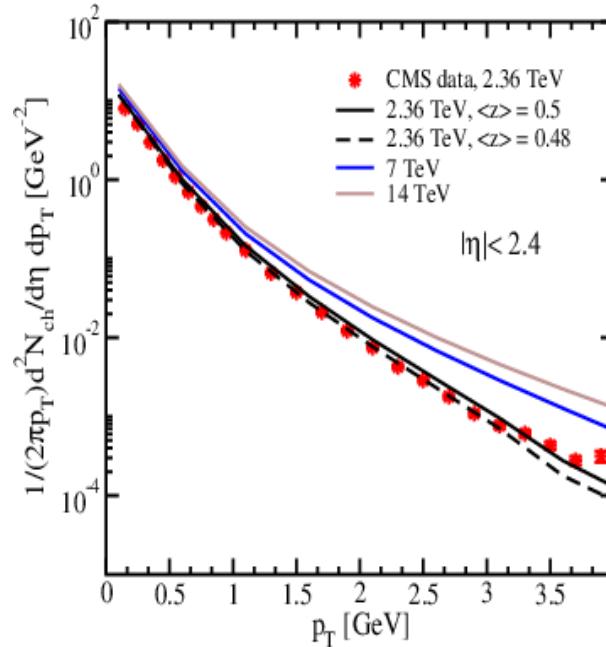
Albacete, Armesto, Mihano, Salgado 2009 for HERA fit

$$\frac{dN}{d^2 p_t dy} = \frac{K}{(2\pi)^2} \sum_i \int_{x_F}^1 \frac{dz}{z^2} x_1 f(x_1, p_t^2) N_i(x_2, p_t/z) D_{h/i}(z, p_t^2)$$

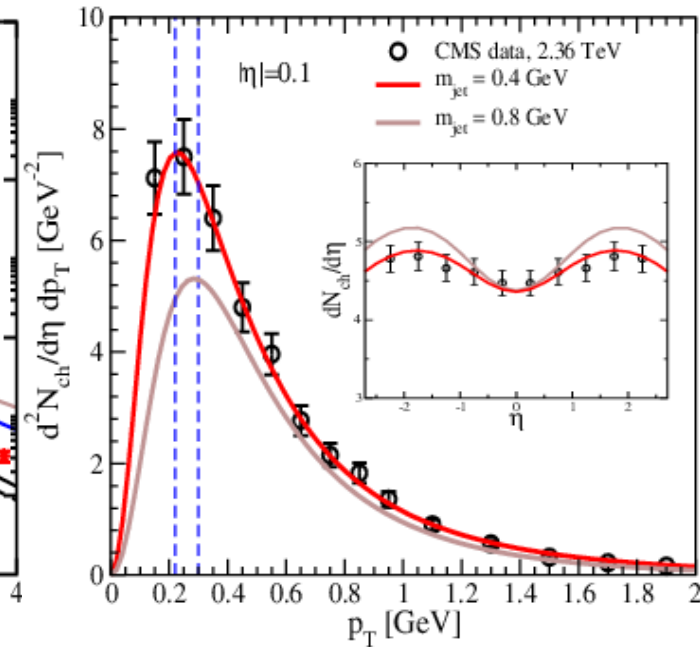
Kt-factorization + FF and LPHD



J.L.Albacete, A. Dumitru, H. Fujii, Y.N. Hep-ph1209.2001



E. Levin and A. H. Rezaeian, Phys. Rev. D82, (2010) 014022, Phys. Rev. D82 (2010) 054003

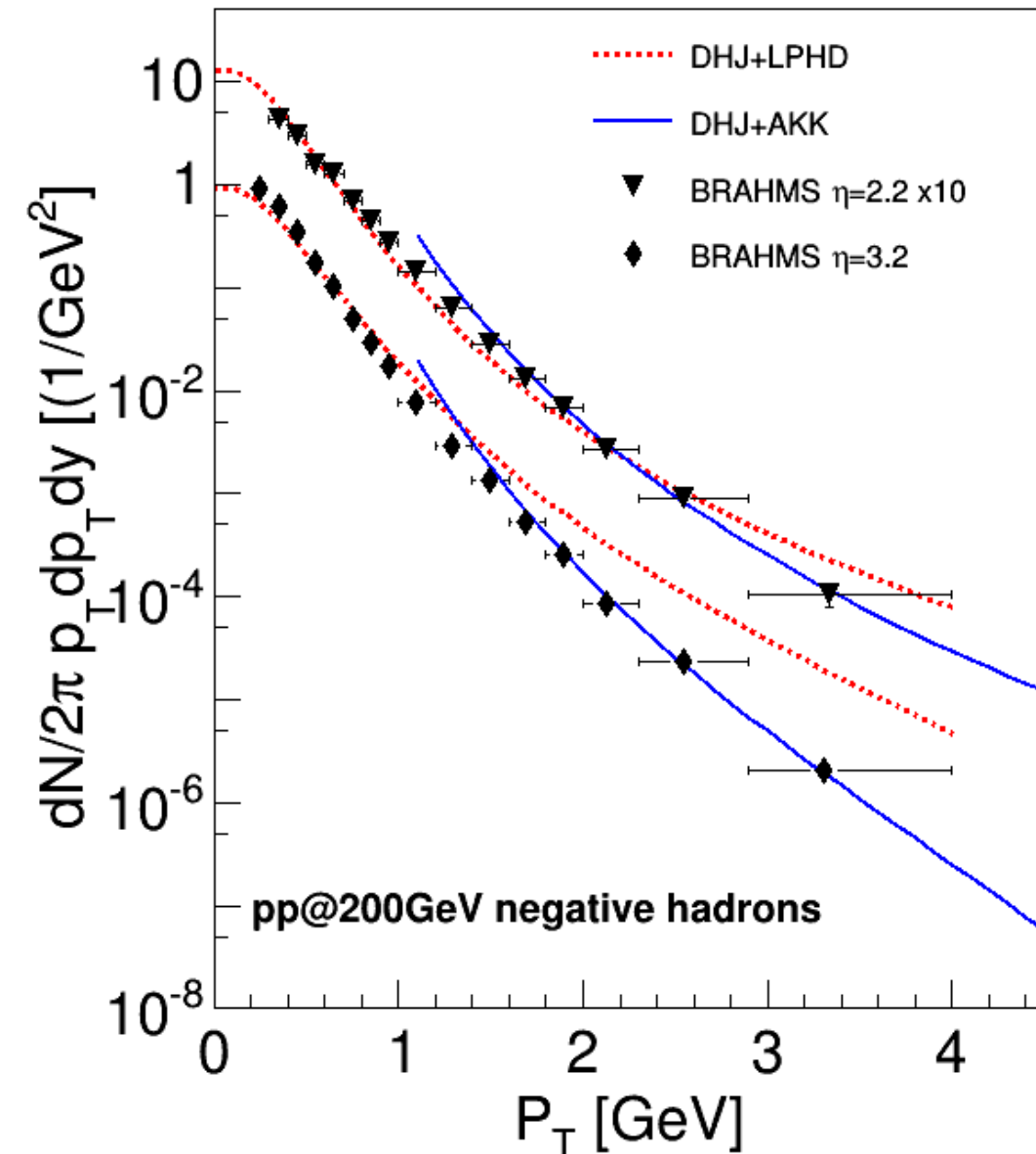


Fragmentation function works at high p_T

$$\frac{d\sigma}{dy dp_T} = \frac{2\alpha_s}{C_F} \frac{1}{p_T^2} \int d^2 k_T \phi(x_1; k_T) \phi(x_2; p_T - k_T)$$

$$p_{\text{jet},T} = \frac{p_T}{\langle z \rangle}, \quad \langle z \rangle = 0.5, \quad p_T \rightarrow \sqrt{m_{\text{jet}}^2 + p_T^2}$$

LPHD and FF in DHJ



Within kt-factrizaton approach,
High pt hadrons are well
described by
the **Fragmentation function**,

Low pt hadrons including
multiplicity are well described
by the **parton-padron duality**.

**More realistic model:
event generator version is needed
for the unified description..**

Monte-Carlo event generator for CGC

First attempt: BBL (Black-Body limit) Monte-Carlo Model
based on kt-factorization and SIBYLL

by

H.J. Drescher, A. Dumitru, M. Strikman, Phys.Rev.Lett. 94 (2005) 2

We would like to develop generator based on

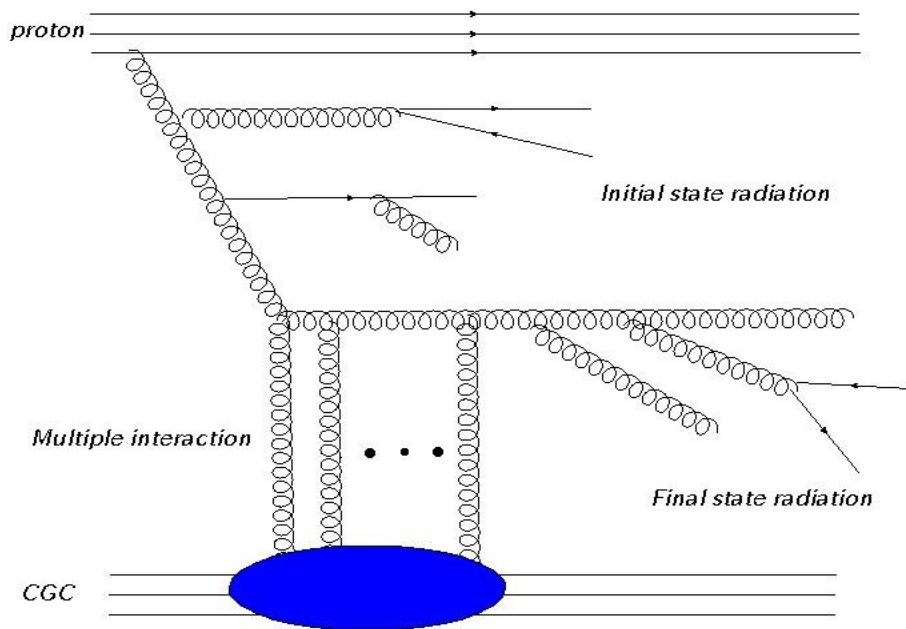
DHJ (Dumitru-Hayashigaki-Jalilian-Marian) formula with rcBK unintegrated gluon dist.

for the description of forward hadron productions.

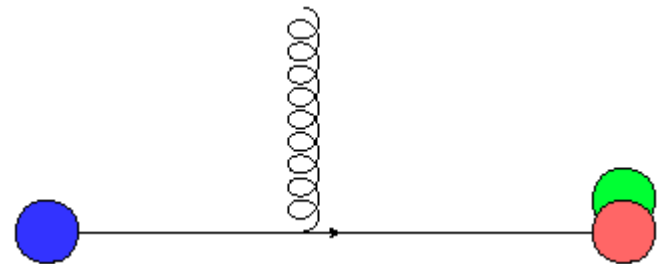
Monte-Carlo Event Generator for DHJ approach

$gg \rightarrow g, gq \rightarrow q$ with initial and final state radiations

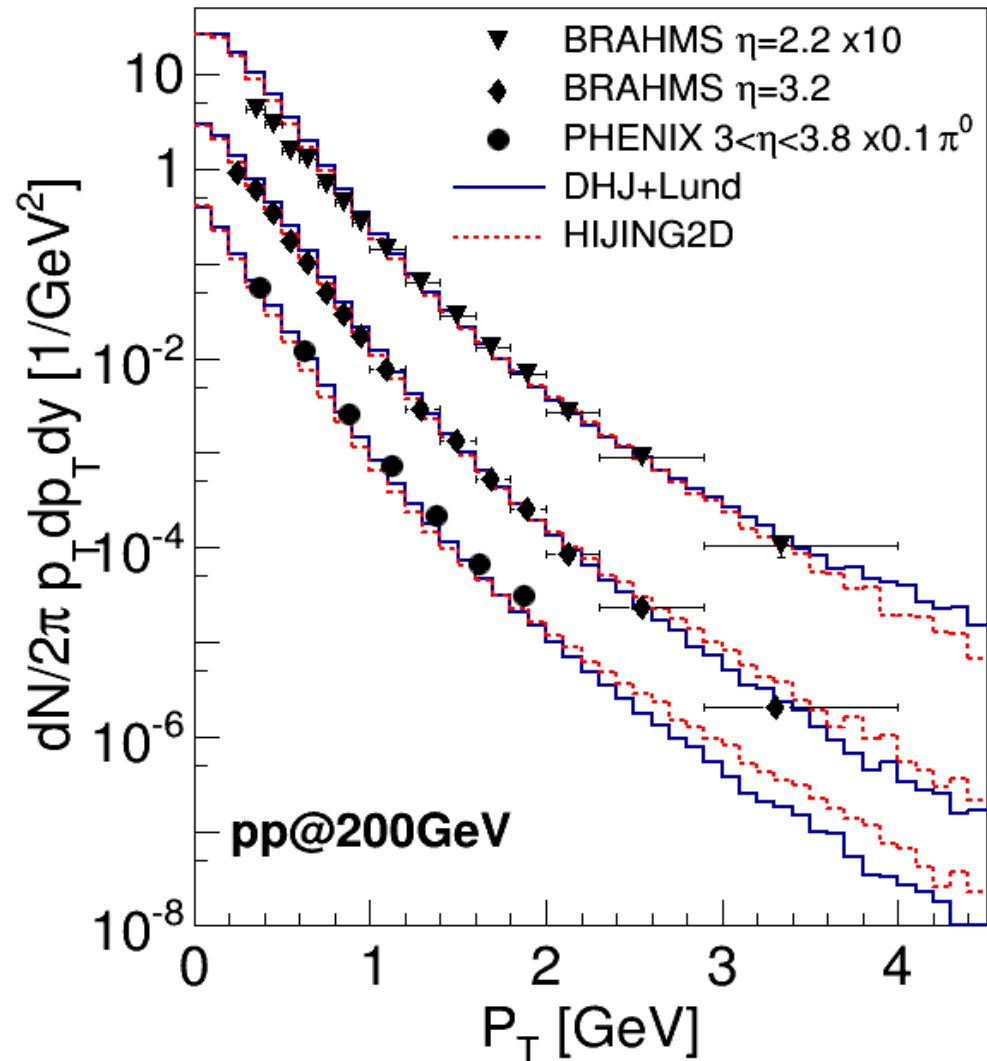
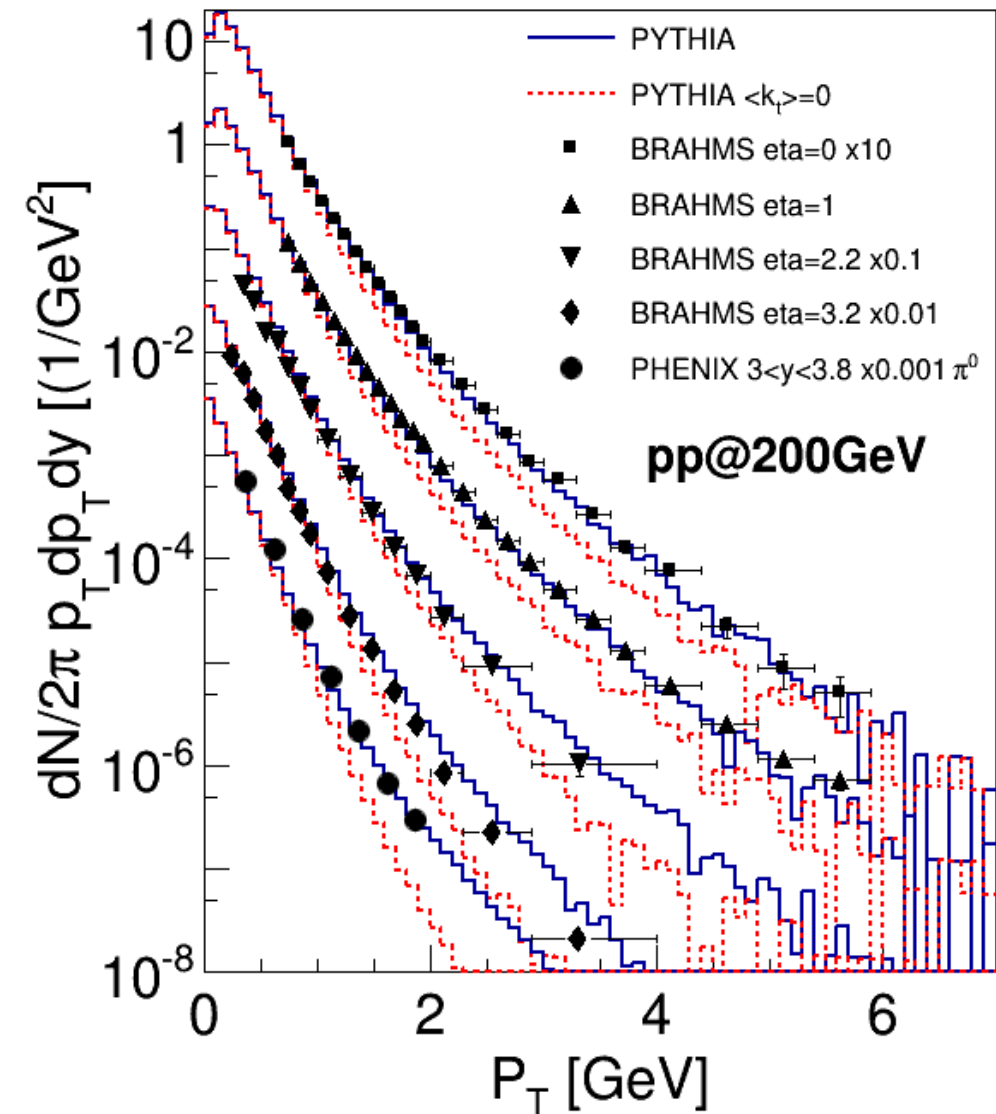
Gluons and quarks are generated according to the DHJ formula.



Hadrons are produced by the Lund string fragmentation model

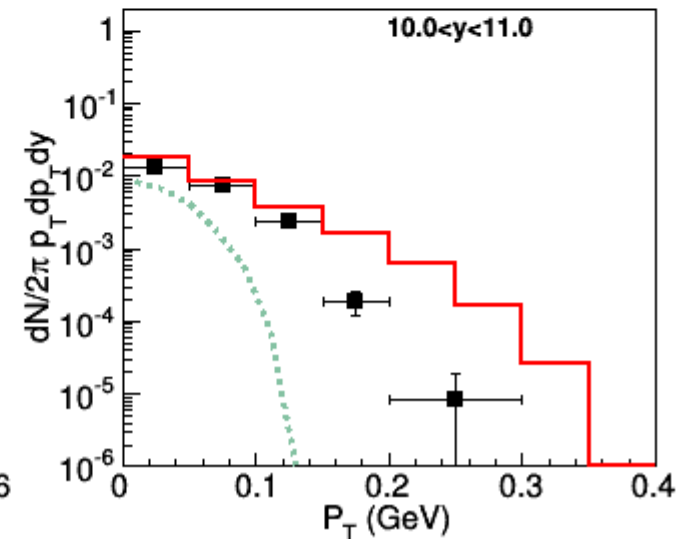
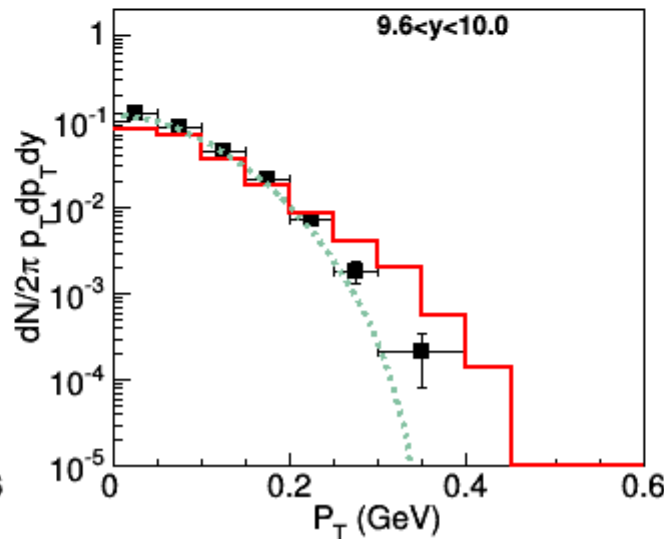
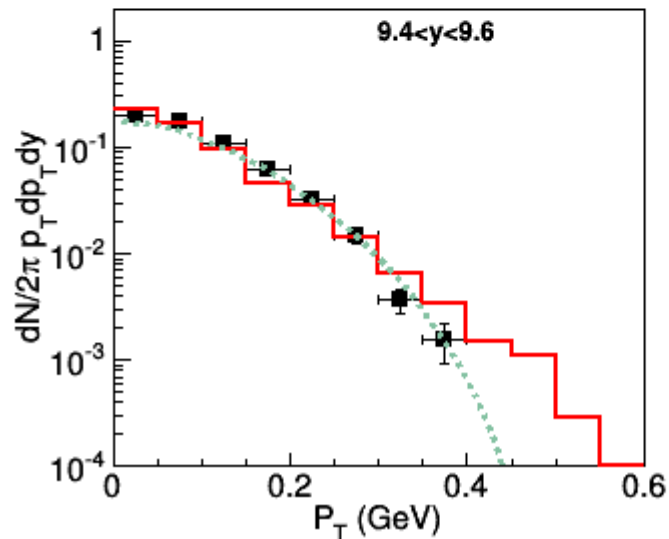
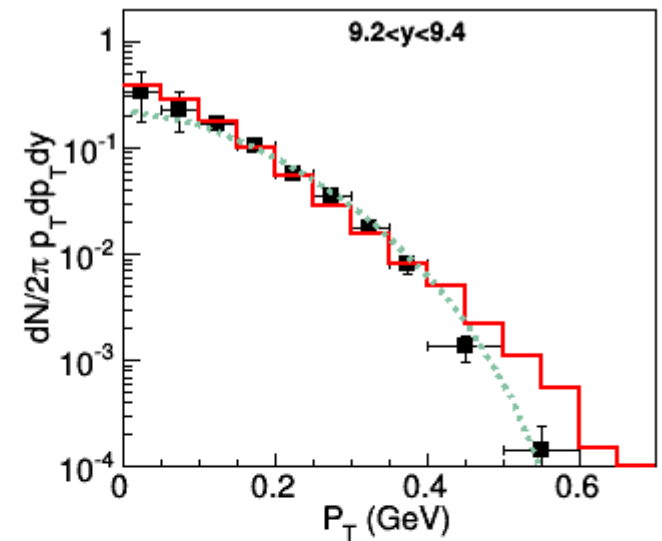
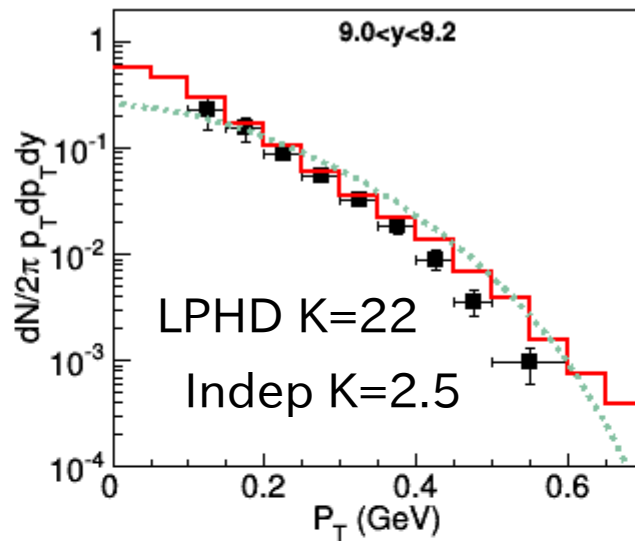
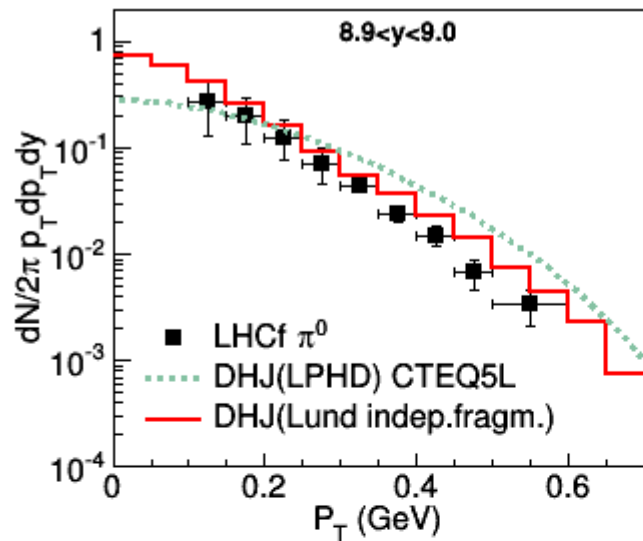


P + P@200GeV negative hadrons

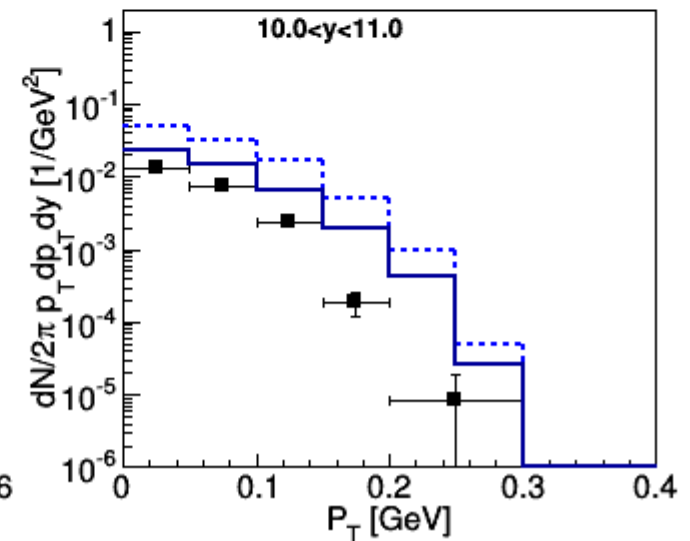
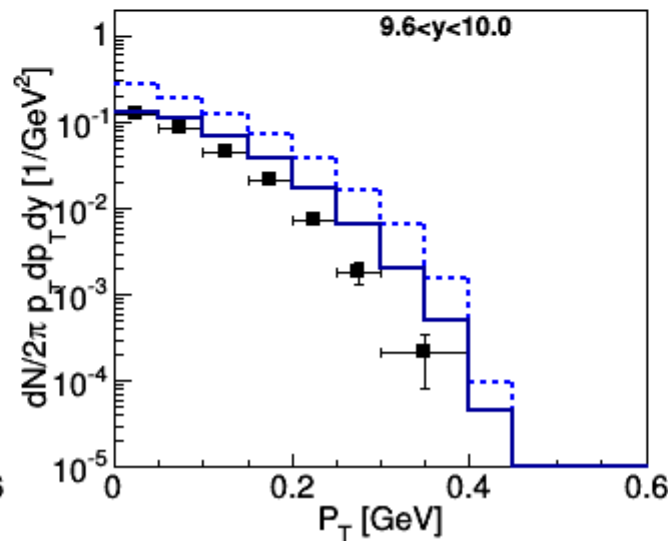
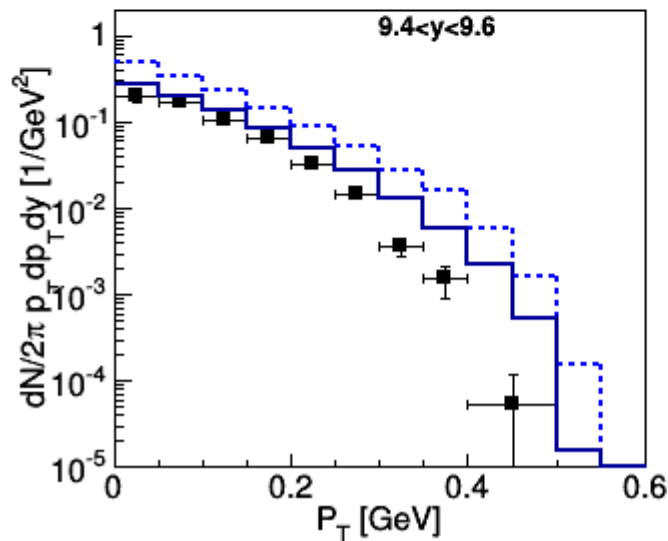
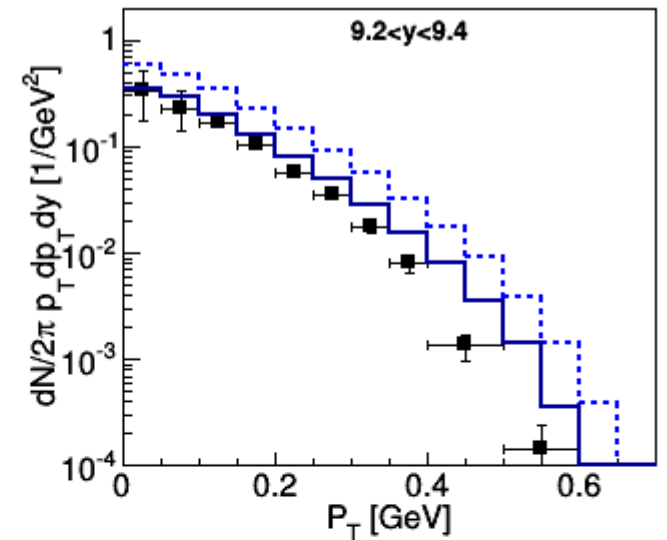
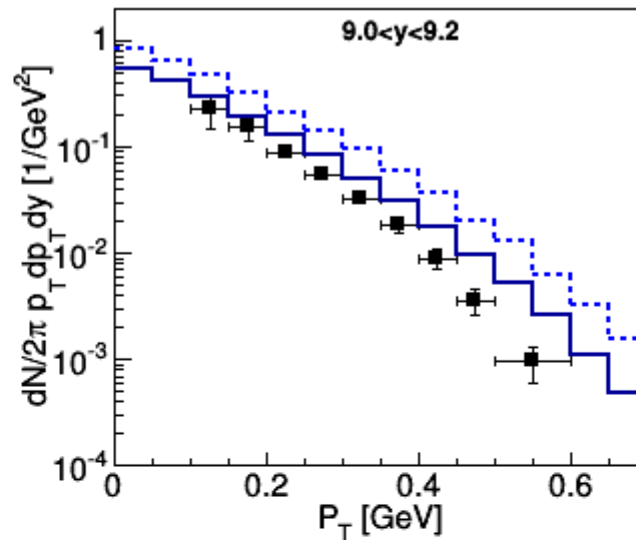
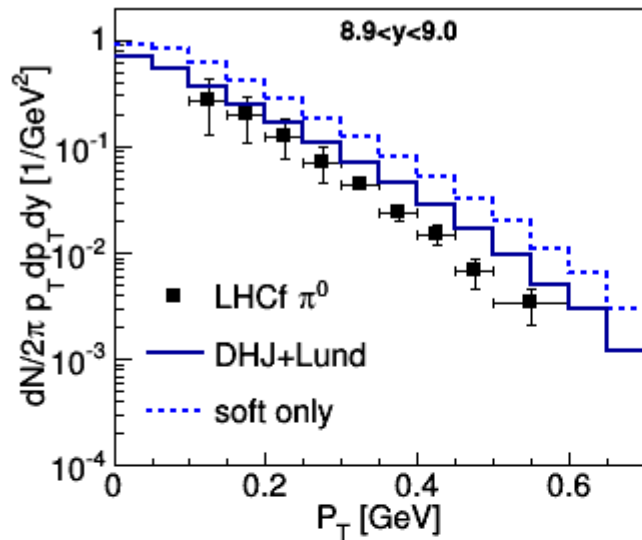


Gluon contribution? LHCf

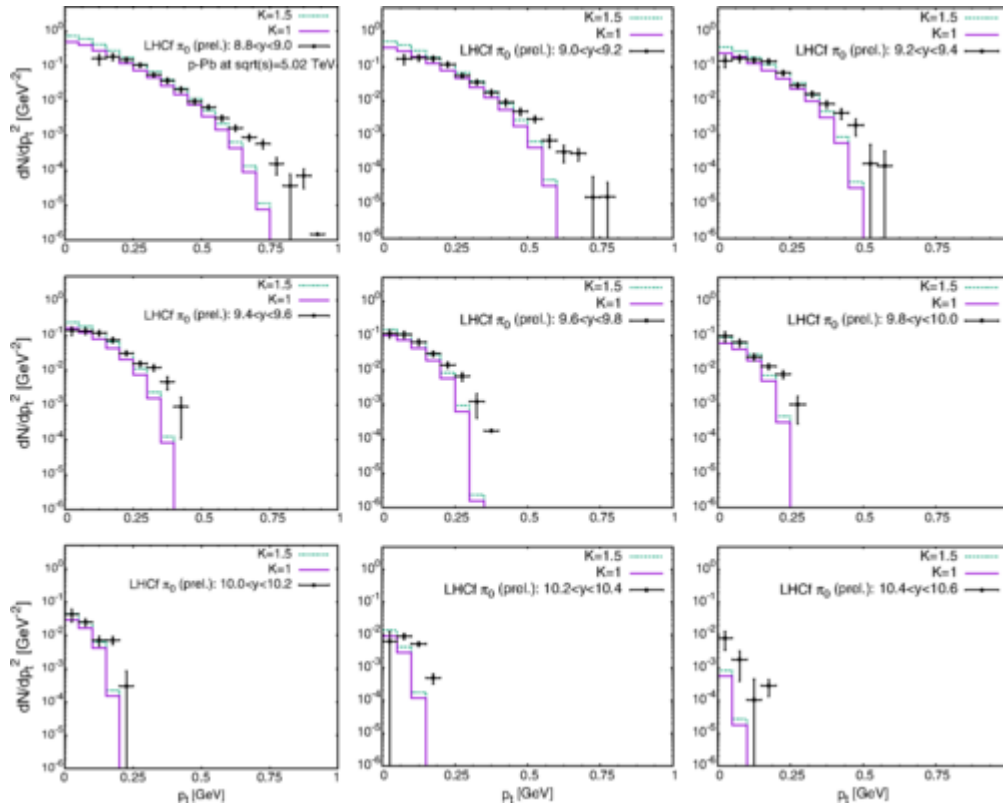
$$\langle z \rangle = (1 + z_{\min})/2 \quad \text{pp@7TeV} \quad x \approx 1 \times 10^{-7}$$



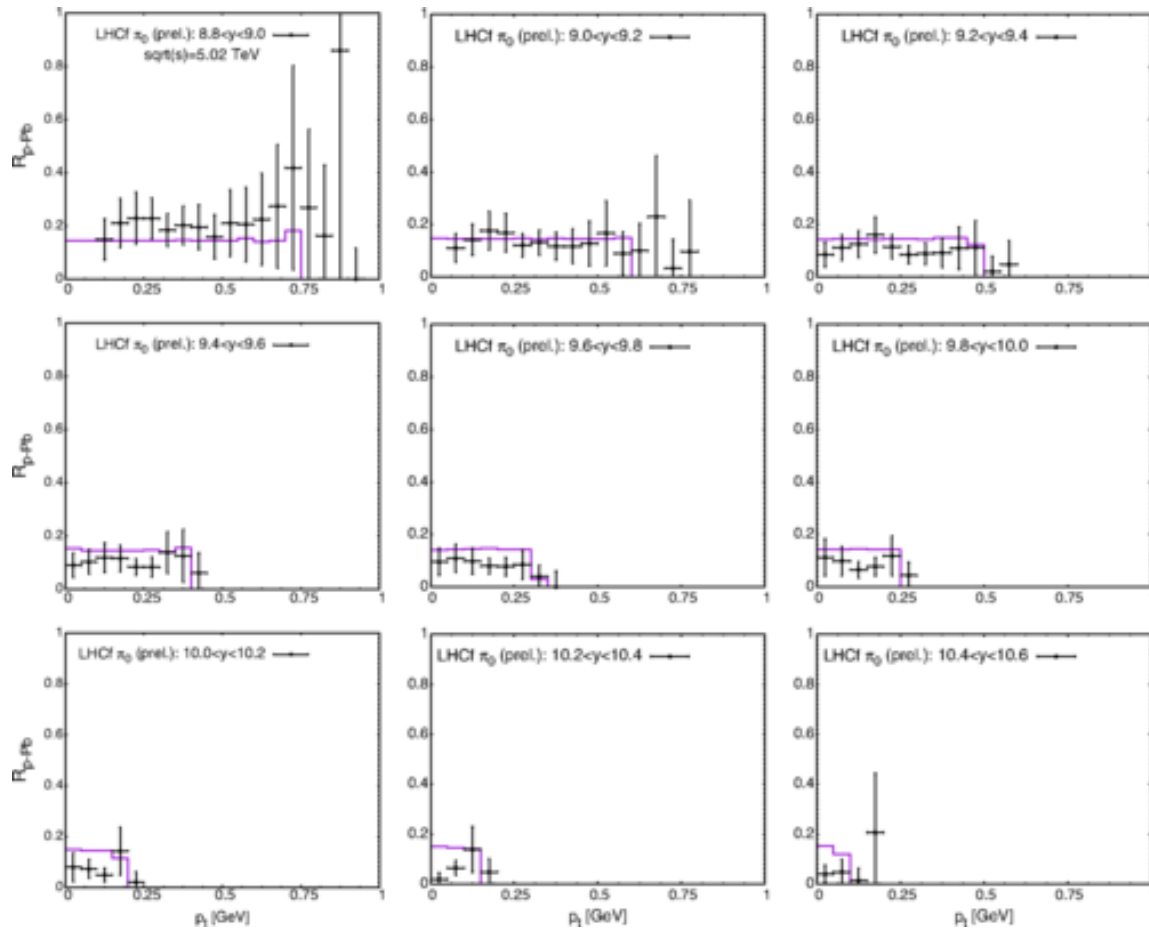
DHJ+Lund v.s. soft string fragm.py8



p+Pb from CGC+Lund



R_pPb from CGC+Lund



Outlook

- Monte-Carlo implementation of Initial state radiation due to x -evolution (rcBK) in the momentum space.
→ one of the sources of fluctuations in particle production.

c.f. CCFM Monte-Carlo CASCADE by H. Jung.

DIPSY event generator: BFKL evolution in the coordinate space based on Mueller's dipole formalism.

- MC generator based on kt -factorization formula
- Extension to p -A collisions.

FritiofP8 (Glauber-Gribov model): C.Bielich, G.Gustafson, L. Lonnblad hep-p/1607.04434

- Extension to AA collisions.
→ How to deal with coherent interactions