Low x and MPI – introduction to the session

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Supported by grant: LIDER/02/35/L-2/10/NCBiR/2011

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Motivation

Typical x at LHC $x=10^{-2}$ → theoretically relevant for onset of low x effects

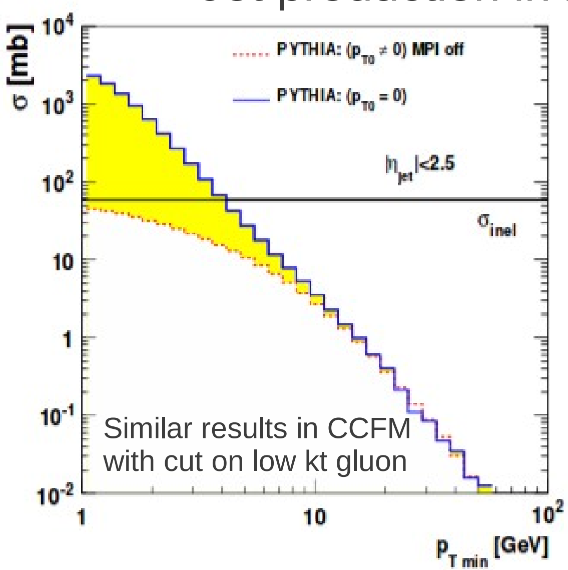
Estimations and MC calculations show that the MPI effects are enhanced at low x.

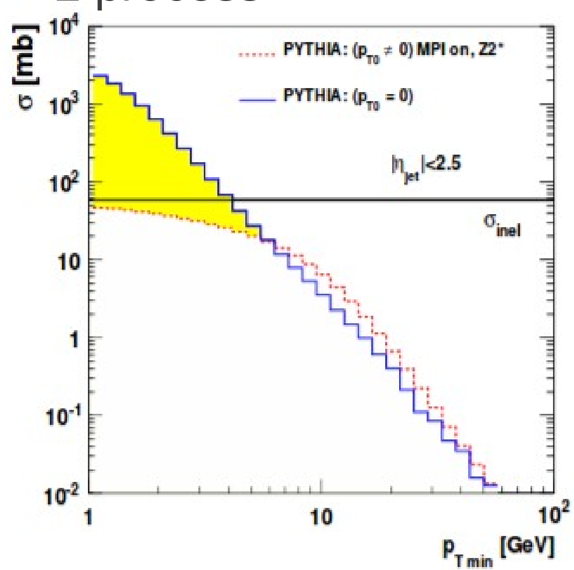
n quarks $$F \sim (x_1 x_2 ... x_n)^{(-1-\lambda_q)} \sim x^{-2n(1-\lambda_q)}, \;\; x_1 \sim x_2 ... \sim x_n$$

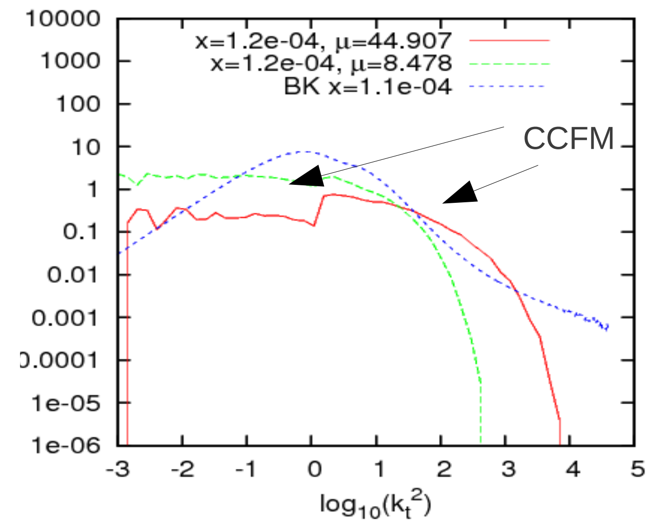
single quark $$F \sim x^{2(-1-\lambda_q)}$$

Diehl, Ostermeier, Schafer '12

Jet production in 2 → 2 process







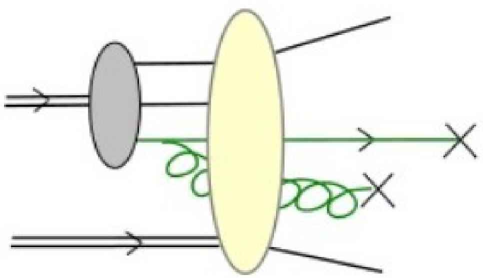
Various apporaches show that supression of gluon density at low p_t is relevant for jet observables and for unitarization Grebenyuk, Hautmann, Jung, Katsas '12.
This rizes a question of interplay of MPI and saturation.

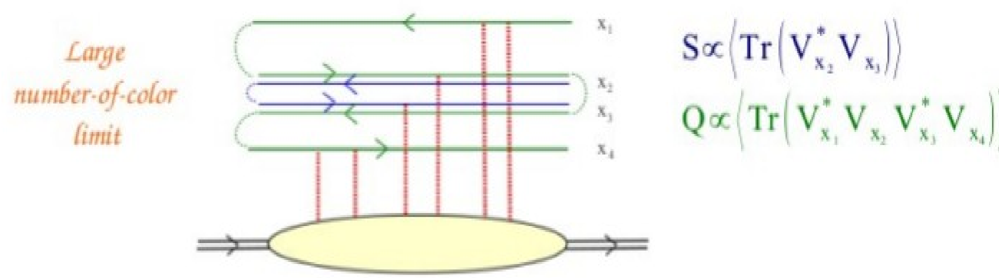
Topics to be addressed during the session

- Search for low x effects →expected signatures via. Mueller-Navelet jets
- Issues concerning saturation at low x. Search for appropriate observables for saturation
  Do nuclear modification factors give hint of saturation?
- Studies of gluon density at low momenta → idea to use Higgs
- MPI → jets and Z boson → understanding jets activity in the forward region
- Unitarization of cross section → the importance of nonperturbative domain
- Is DGLAP enough? → via studies of Drell-Yan at IR region
- Hadrond dependence of MPI → Scalling of MPI with nucleon/nucleon collisions
- Low x with jets in forward region. New tools for evaluation of large class of observables in low x framework

Further topics not in the session but relevant. To be eventually discussed

- Interplay, or relations between saturation and MPI, usage of BKP equations for multi gluons
- Monte Carlo developements
- More complicated factorization theorems following from CGC (Dominguez, Huan, Marquet, Xiao '11)
- Different unintegrated parton densities for different processes
  (P. Mulders talk QCD@LHC2013)



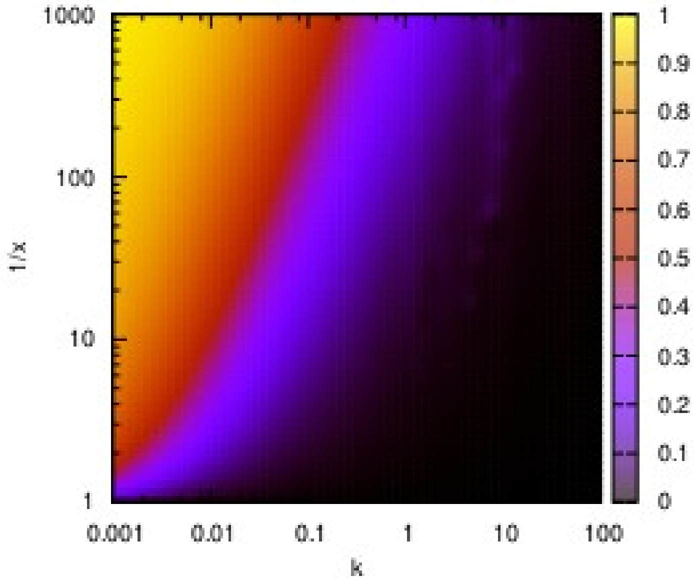


$$\frac{d\sigma^{(pA\to \mathrm{Dijet}+X)}}{d\mathcal{P}.\mathcal{S}.} = \sum_q x_1 q(x_1) \frac{\alpha_s^2}{\hat{s}^2} \left[\mathcal{F}_{qg}^{(1)} H_{qg\to qg}^{(1)} + \mathcal{F}_{qg}^{(2)} H_{qg\to qg}^{(2)} \right]$$
$$+ x_1 g(x_1) \frac{\alpha_s^2}{\hat{s}^2} \left[\mathcal{F}_{gg}^{(1)} \left(H_{gg\to q\bar{q}}^{(1)} + \frac{1}{2} H_{gg\to gg}^{(1)} \right) \right.$$
$$\left. + \mathcal{F}_{gg}^{(2)} \left(H_{gg\to q\bar{q}}^{(2)} + \frac{1}{2} H_{gg\to gg}^{(2)} \right) + \frac{1}{2} \mathcal{F}_{gg}^{(3)} H_{gg\to gg}^{(3)} \right]$$

- applicable in bac-to-back region
- for not too hard jets
- issues of higher order corrections to evolution
- two universal objects → dipole and quadrupole
- Dominguez, Marquet,Stasto,Xiao '13
- More than one gluon density

Saturation and exclusive evolution

BK

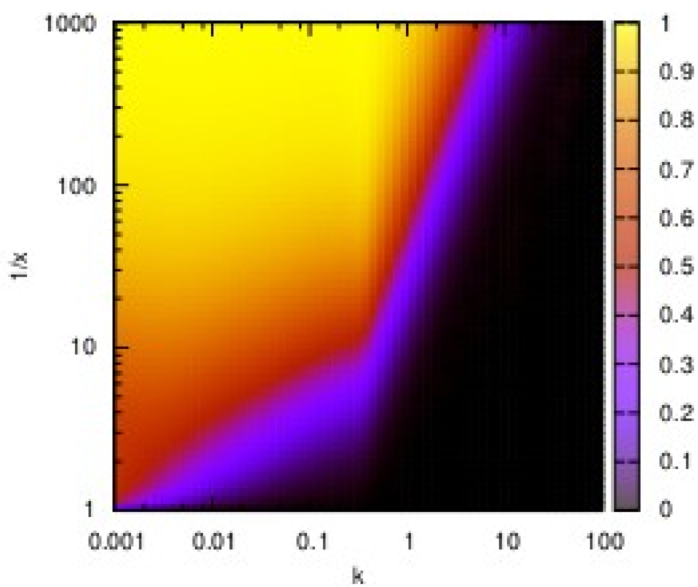


Relative differences between linear and nonlinear

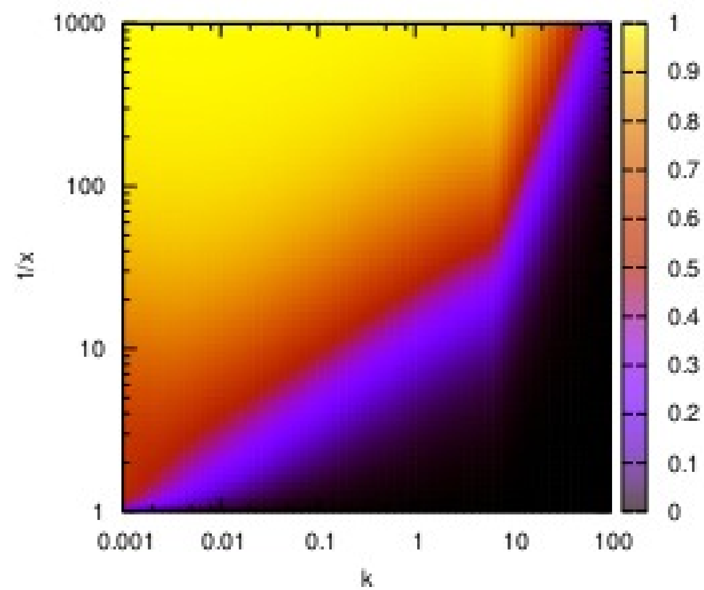
$$\beta(x,k,p) = \frac{|\mathcal{E}_{CCFM}(x,k,p) - \mathcal{E}_{KGBJS}(x,k,p)|}{\mathcal{E}_{CCFM}(x,k,p)}$$

Kutak,Toton '13

KGBJS



Hard scale, p =1



Hard scale, p=10