Modified BK and heavy quarks

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1. Motivation
2. Extended Balitzkij-Kovchegov equation
3. Heavy quark production
4. Conclusions

1.Motivations

Reliable description of proceses towards the region of very small values of x and large k^2

$\downarrow$

- Constrains on parton distributions implied by HERA data.
- BFKL dynamics with subleading corrections.
- Complete DGLAP evolution i.e. large k^2.
- Non-linear screening effects built into the evolution equations.
- Mass of heavy quark justifies application of presented formalism

2.Extended Balitzkij-Kovchegov(BK) equation

Nonlinear evolution equation for unintegrated gluon distribution.

$$f(x,k^2) = \tilde{f}^{(0)}(x,k^2) + K^1 \otimes f - K^2 \otimes f^2 \quad (1)$$

where

- $\tilde{f}^{(0)}(x,k^2) \rightarrow$ input
- $K^1 \otimes f \;\rightarrow$ BFKL + running coupling + kinematic constraint on gluon emission $k'^2 < \frac{k^2}{z}$(dominant subleading BFKL effects) and inclusion of DGLAP evolution
- $K^2 \otimes f^2$ term that takes care for saturation effects

$$K^2 \otimes f^2 = \left(1 - k^2 \frac{d}{dk^2}\right)^2 \frac{k^2}{R^2}$$

$$\int_x^1 \frac{dz}{z} \left[\int_{k^2}^{\infty} \frac{dk'^2}{k'^4} \alpha_s(k'^2) ln \left(\frac{k'^2}{k^2} \right) f(z,k'^2) \right]^2$$

General structure of modified BK comes from BK under assumtion that target is uniform and large in comparison to projectile.

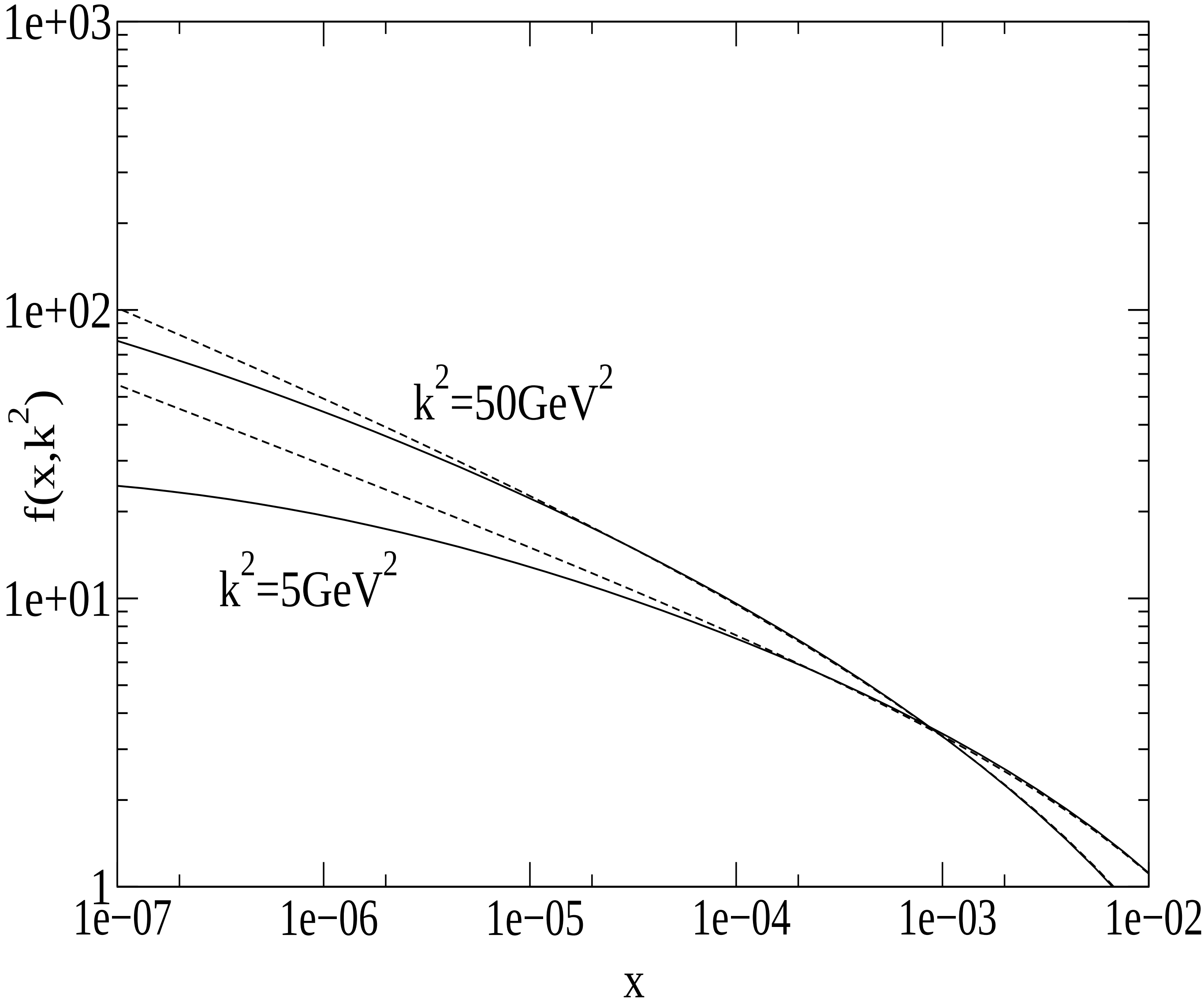


Figure 1: Linear equation vs nonlinear

Origin of suppresion of $f(x, k^2)$

- At very small x the **linear** (DGLAP or BFKL) evolution generates strong increase of the gluon distributions for $x \longrightarrow 0$ which eventually violates unitarity.
- Non-linear screening corrections tame the growth at small x.
- Emergence of the **saturation scale** $Q_s^2(x) \sim x^{-\lambda}$
- Non-linear effects in the unintegrated gluon distributions are small (eventually negligible) for $k^2 > Q_s^2(x)$.
- Non-linear effects are very strong $\longrightarrow$ **saturation** for $k^2 < Q_s^2(x)$
- For $k^2 \ll Q_s^2(x)$, $f \ll f^{linear}$.

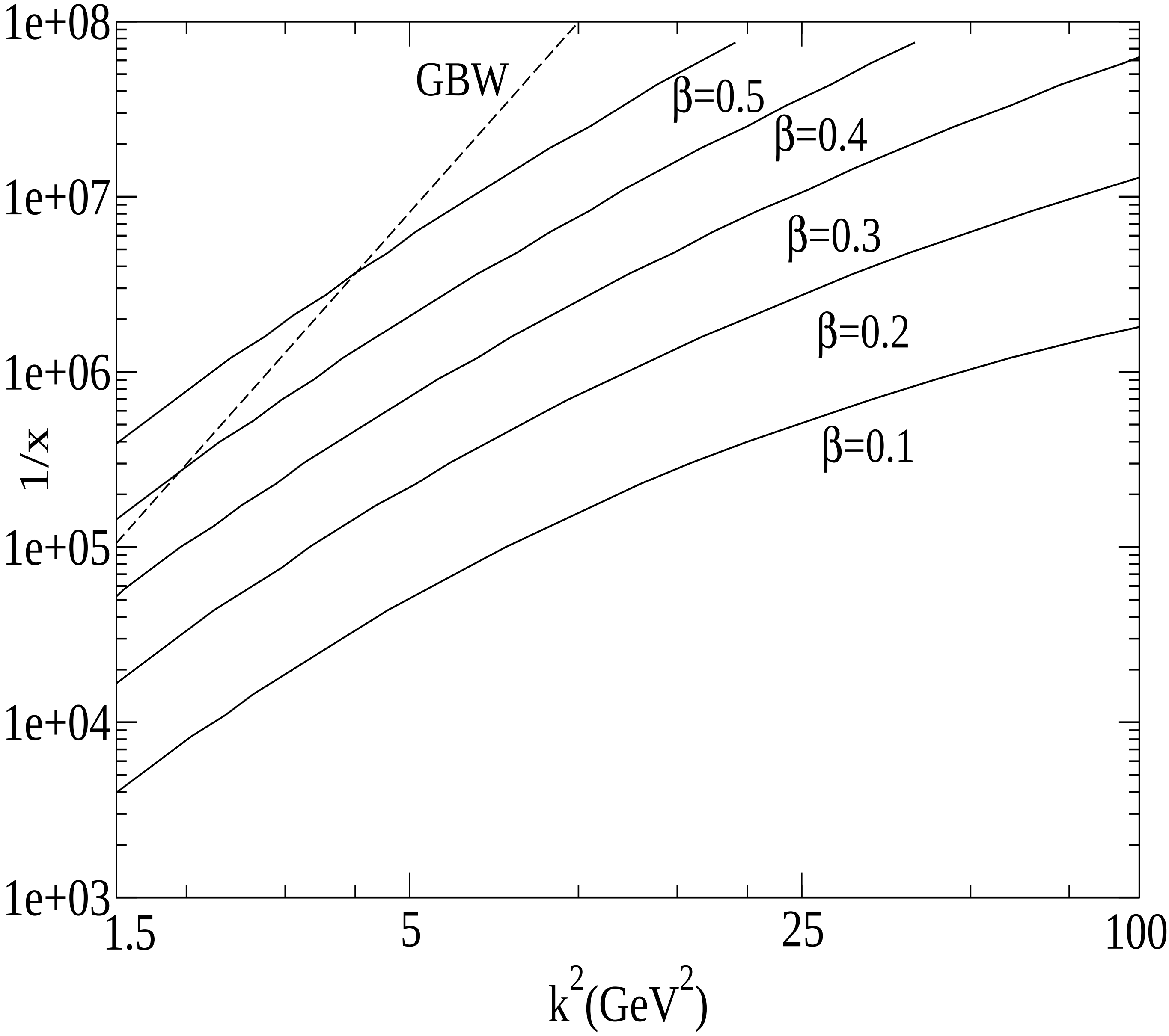
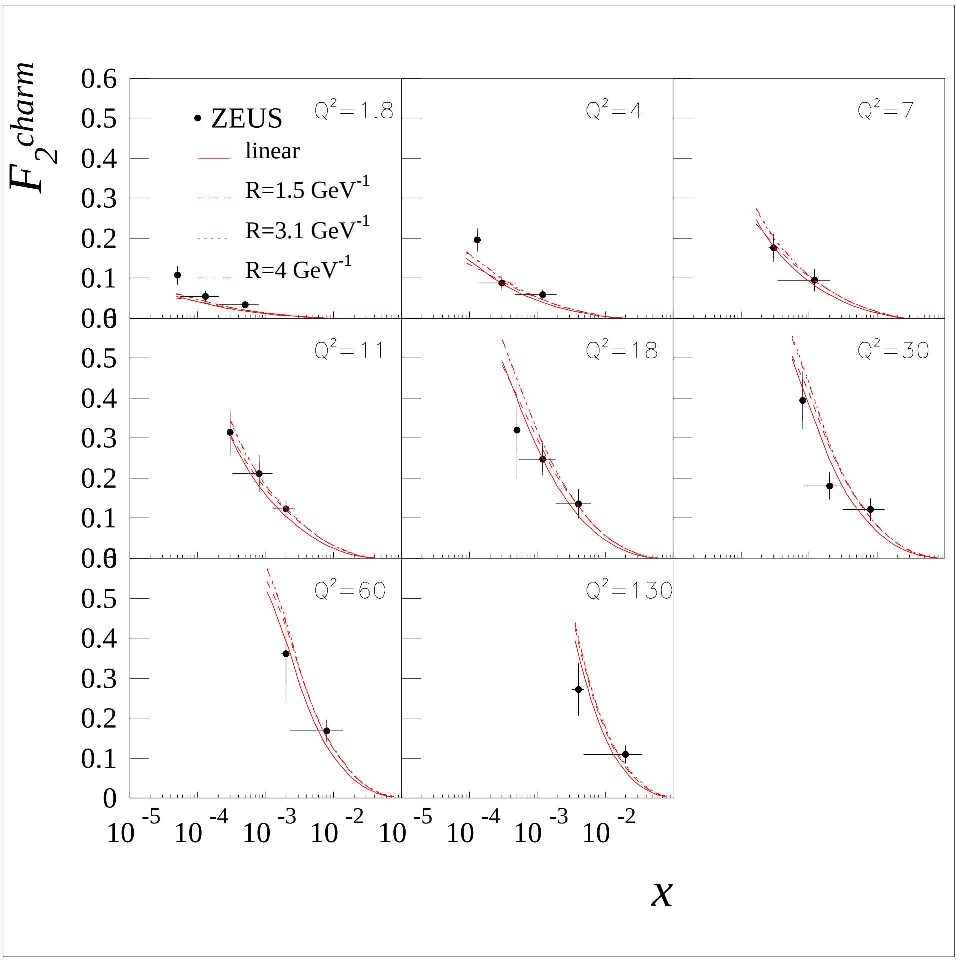


Figure 2: Phenomenologically motivated critical line, $\beta = \frac{f_l(x,k^2) - f_{nl}(x,k^2)}{f_l(x,k^2)}$

4. Heavy quark production

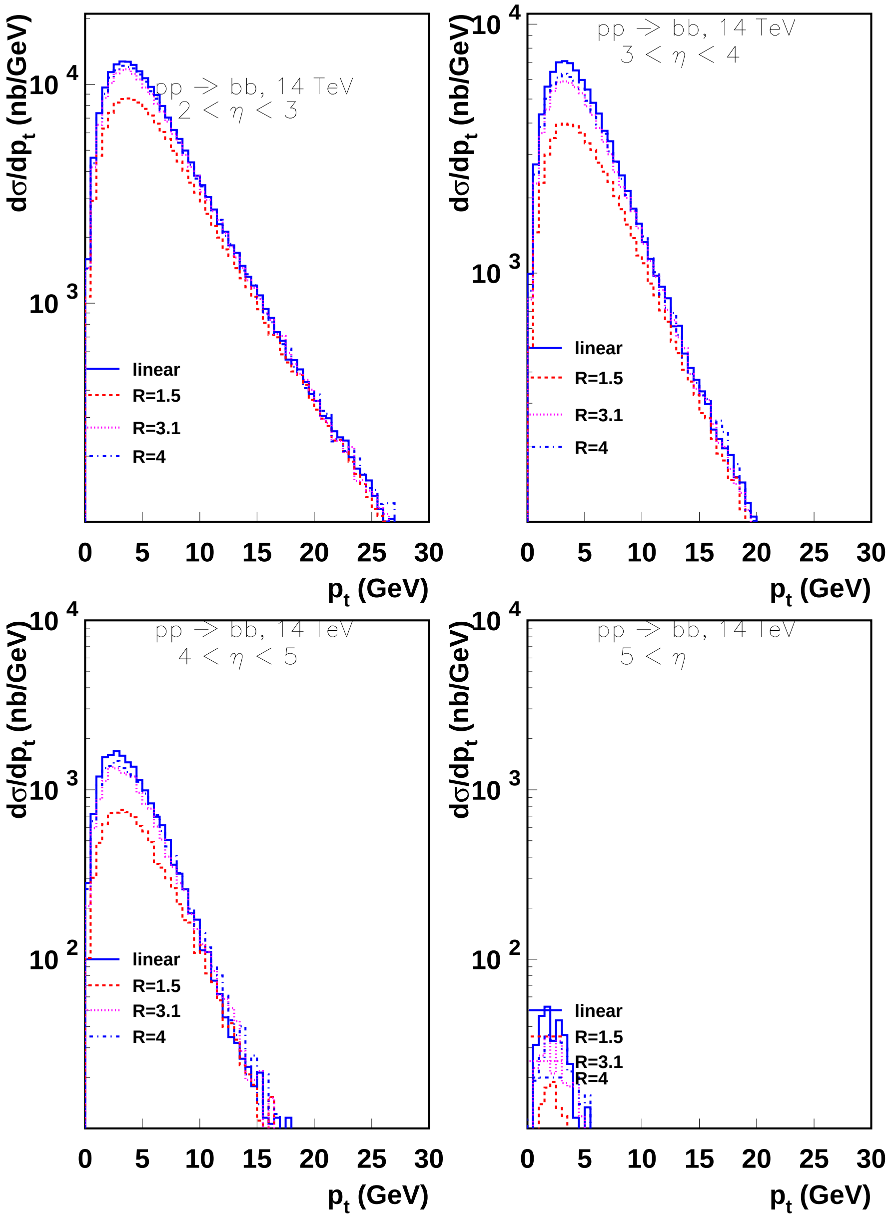
HERA, Modified BK and Cascade give us $F_2^{cc}(x, Q^2)$:

$\downarrow$



For LHC we estimate:

- σ_{diff} for $pp \to b\bar{b}$



For LHC we estimate:

- $\frac{\sigma_{tot}(R=3.1 GeV^{-1})}{\sigma_{tot}(linear)} = .97$
- $\frac{\sigma_{tot}(R=1.5 GeV^{-1})}{\sigma_{tot}(linear)} = .8$

5. Conclusions

Presented formalism describes data and allows us to predict cross section for production of heavy quarks in situation when partons form very dense system and eventually saturate. Saturation is also required to unitarise cross section which is violated by BFKL.