QCD corrections to the electroproduction of hadrons with high pT

Rodolfo Sassot

Universidad de Buenos Aires

DIS05, Madison April 27, 2005

In collaboration with A. Daleo and D. de Florian,

based on Phys. Rev. D71 034013 (2005)
and references therein.

Outline:

- theory & phenomenological motivation & background

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- phenomenological consequences & data

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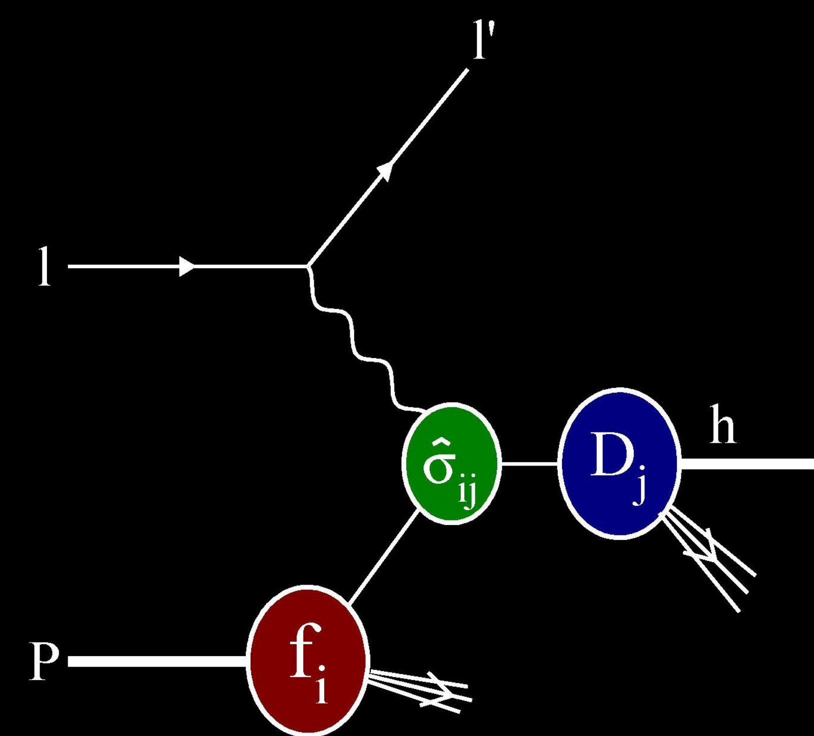

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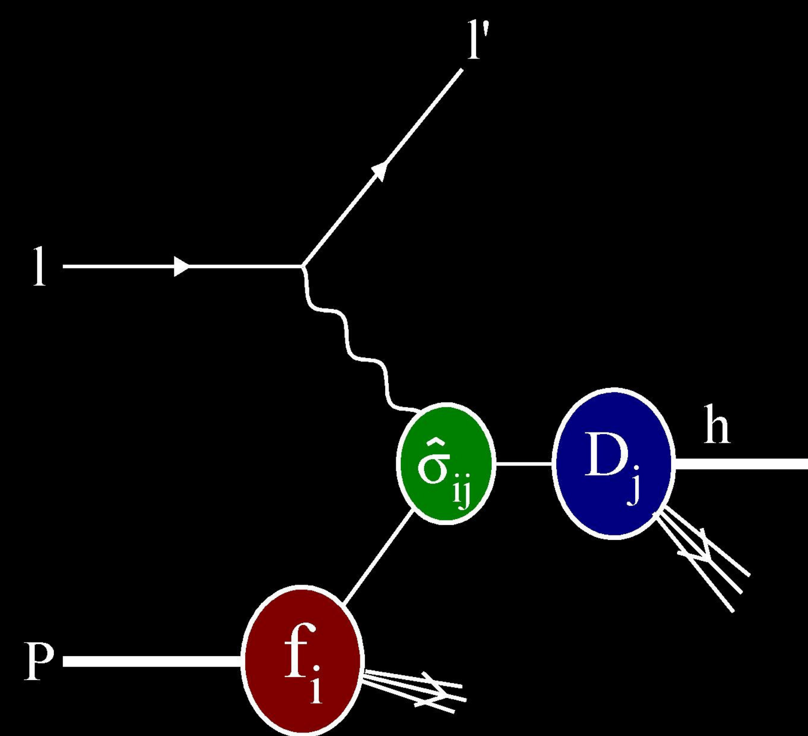

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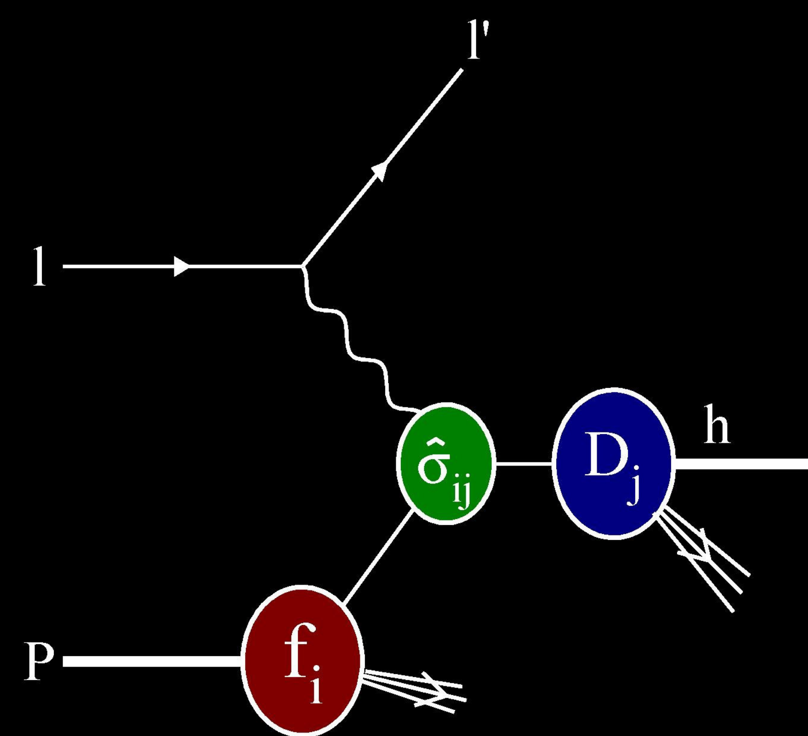

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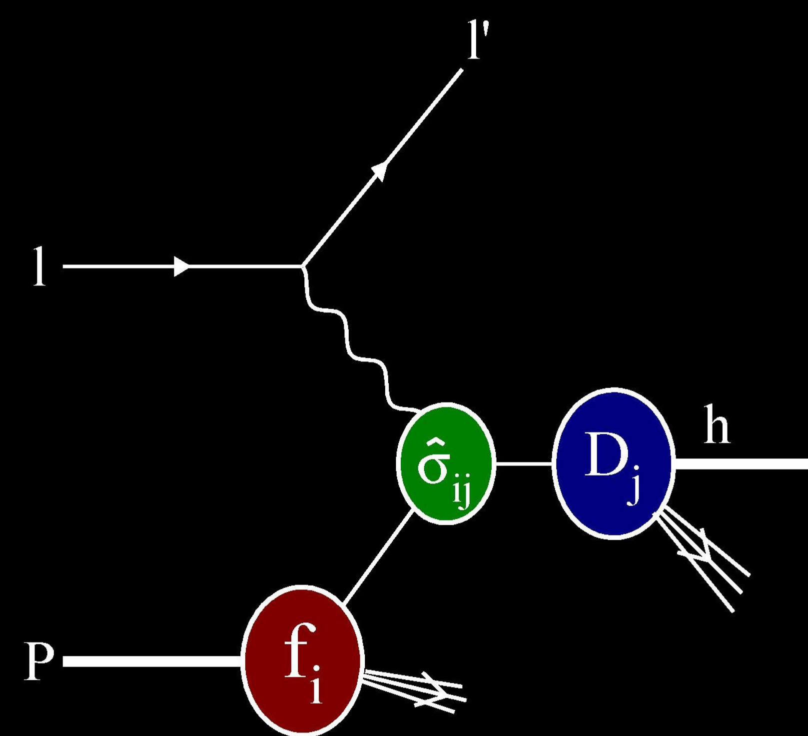

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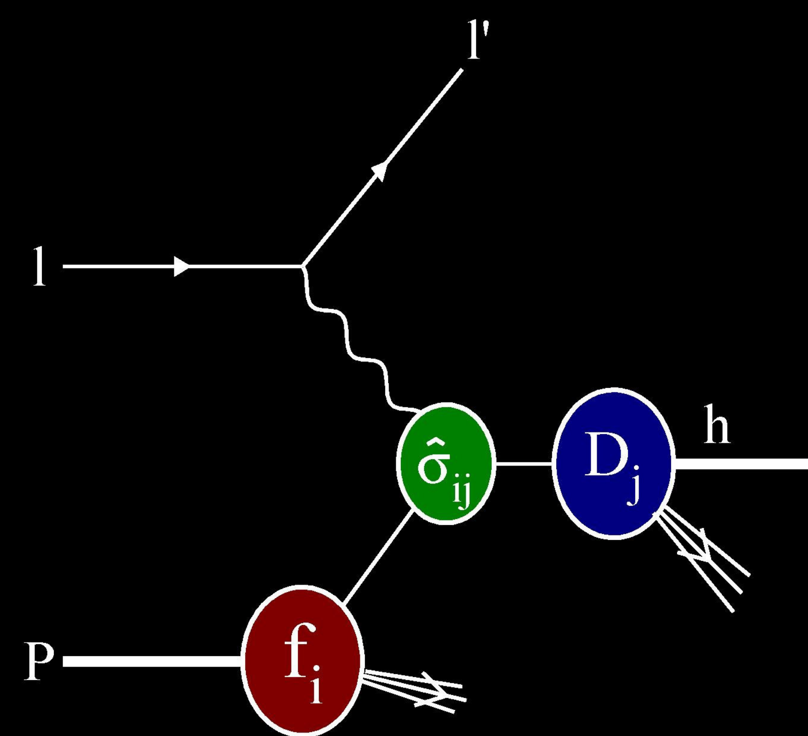

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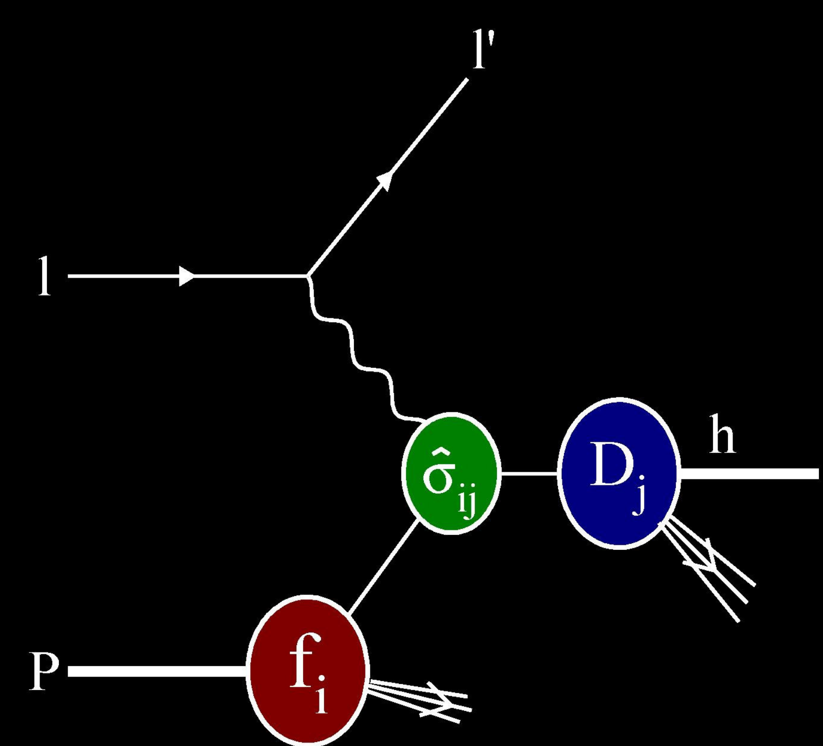

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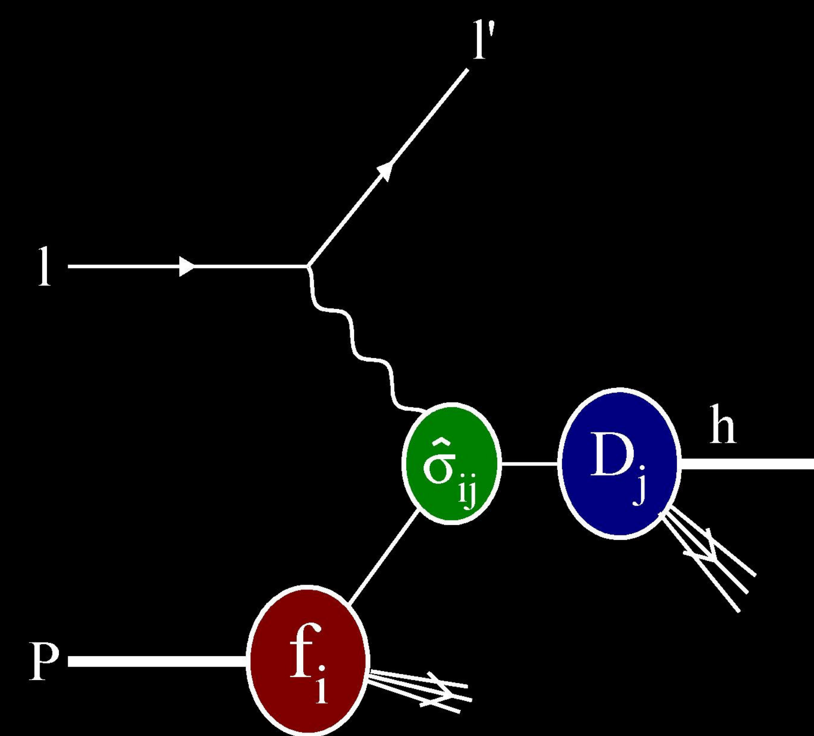

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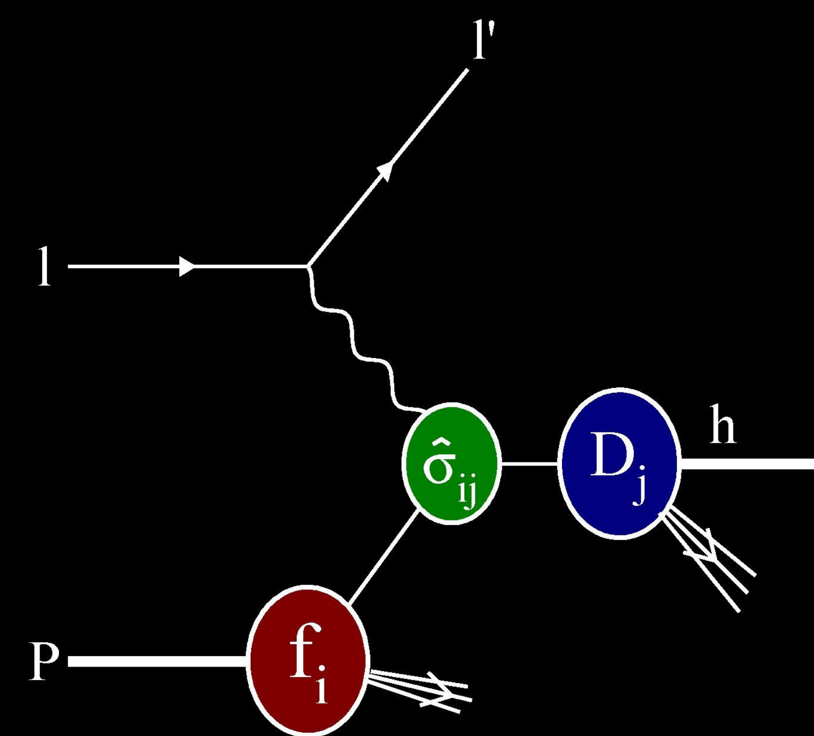

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- $\mathcal{O}(\alpha_s^1)$ approximation may not be good enough!

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$$y \equiv -\frac{u}{Q^2+s} \qquad z \equiv \frac{(Q^2+s)(s+t+u)}{s\,(Q^2+s+u)} \qquad y, z \in [0,1]$$

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if $|p_T| > 0$ only $z = 0$

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$C_{ij}^{(2)}(\varrho, y, z)$ coefficients are finite but rather long because of $\mathcal{O}(\alpha_s^2)$

NLO: $\mathcal{O}(\alpha_s^2)$

Real contributions

$$\left\{\begin{array}{lll} \gamma + q(\bar{q}) & \rightarrow & g + g + q(\bar{q}) \\ \gamma + q_i(\bar{q}_i) & \rightarrow & q_i(\bar{q}_i) + q_j + \bar{q}_j \quad (i \neq j) \\ \gamma + q_i(\bar{q}_i) & \rightarrow & q_i(\bar{q}_i) + q_i + \bar{q}_i \\ \gamma + g & \rightarrow & g + q + \bar{q} \end{array}\right.$$

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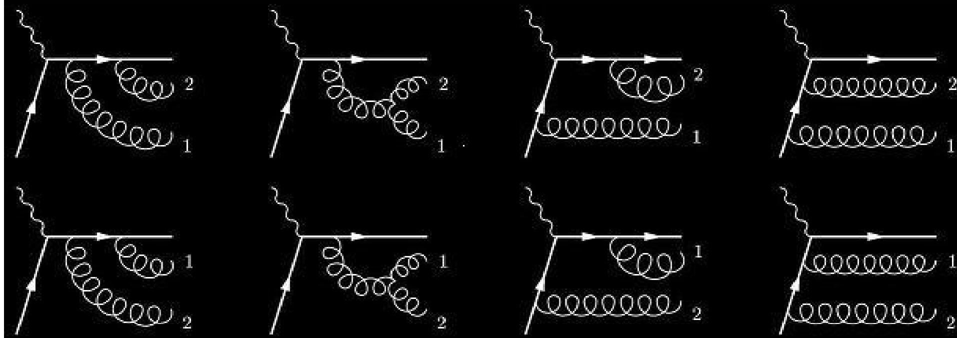
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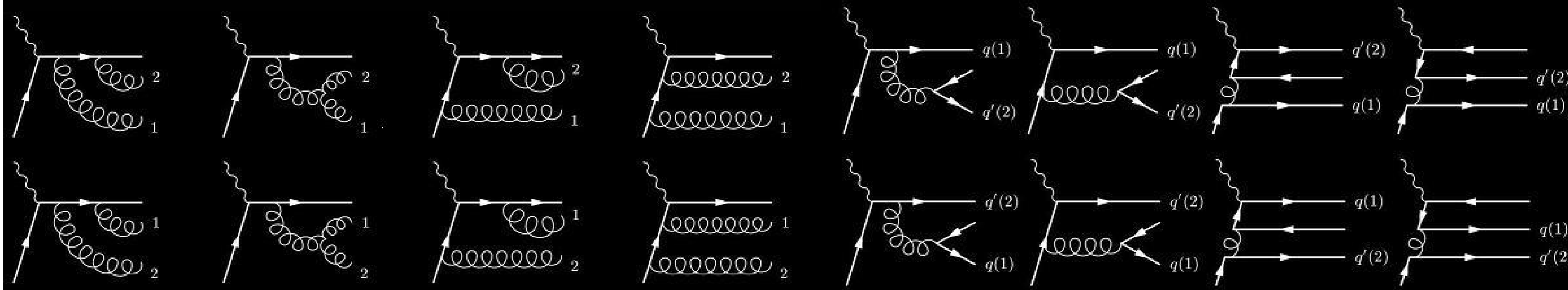
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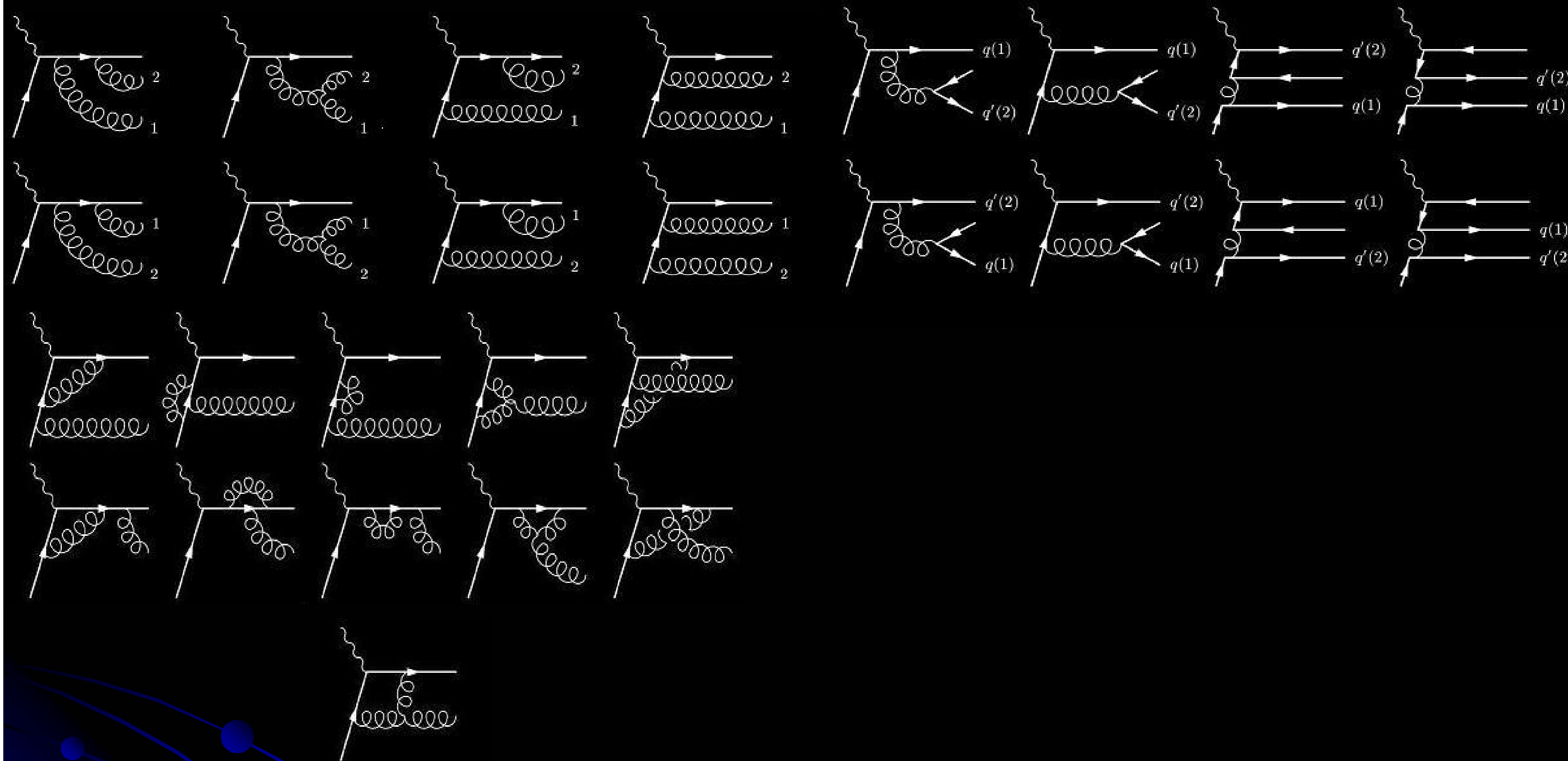

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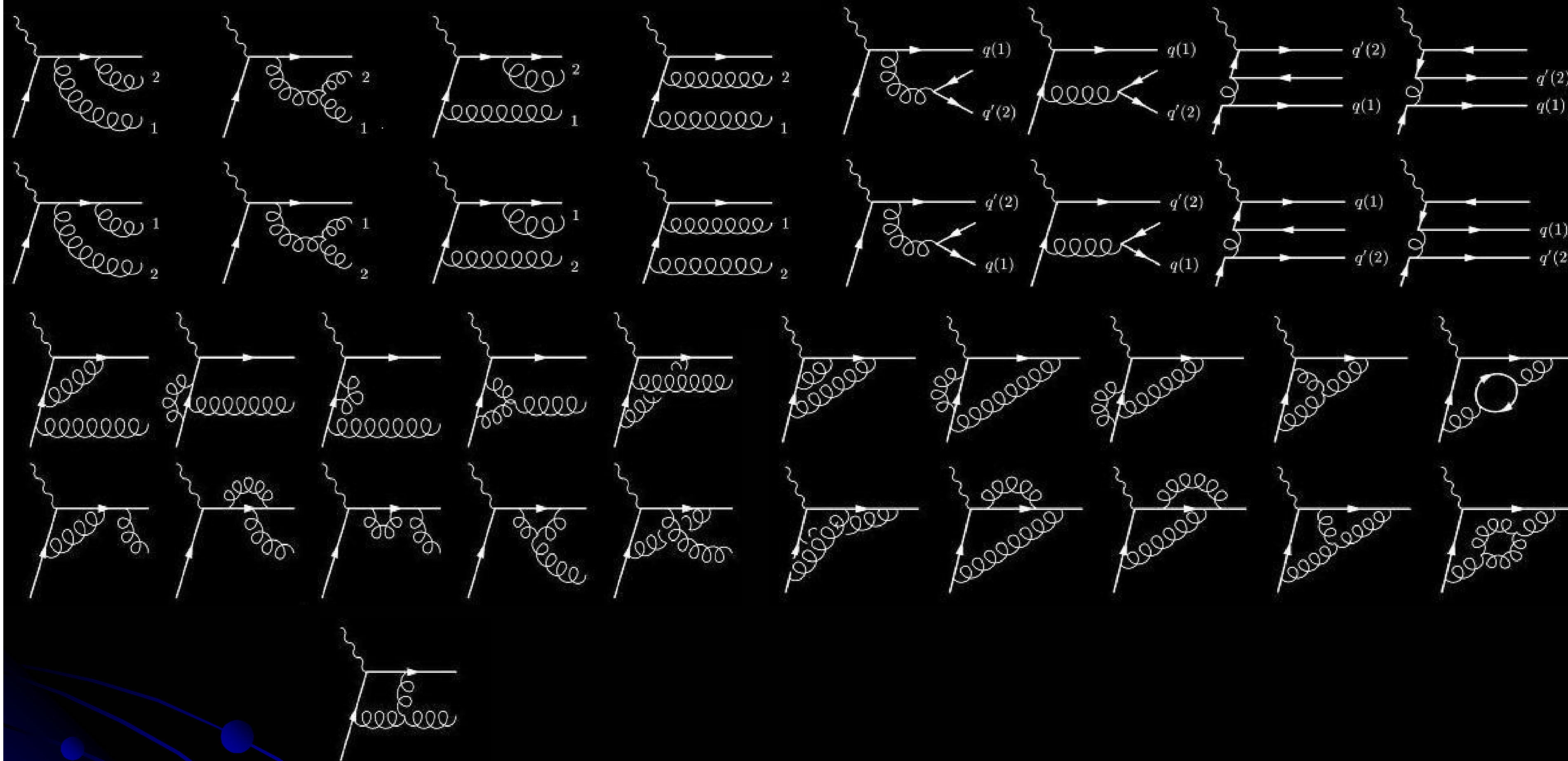

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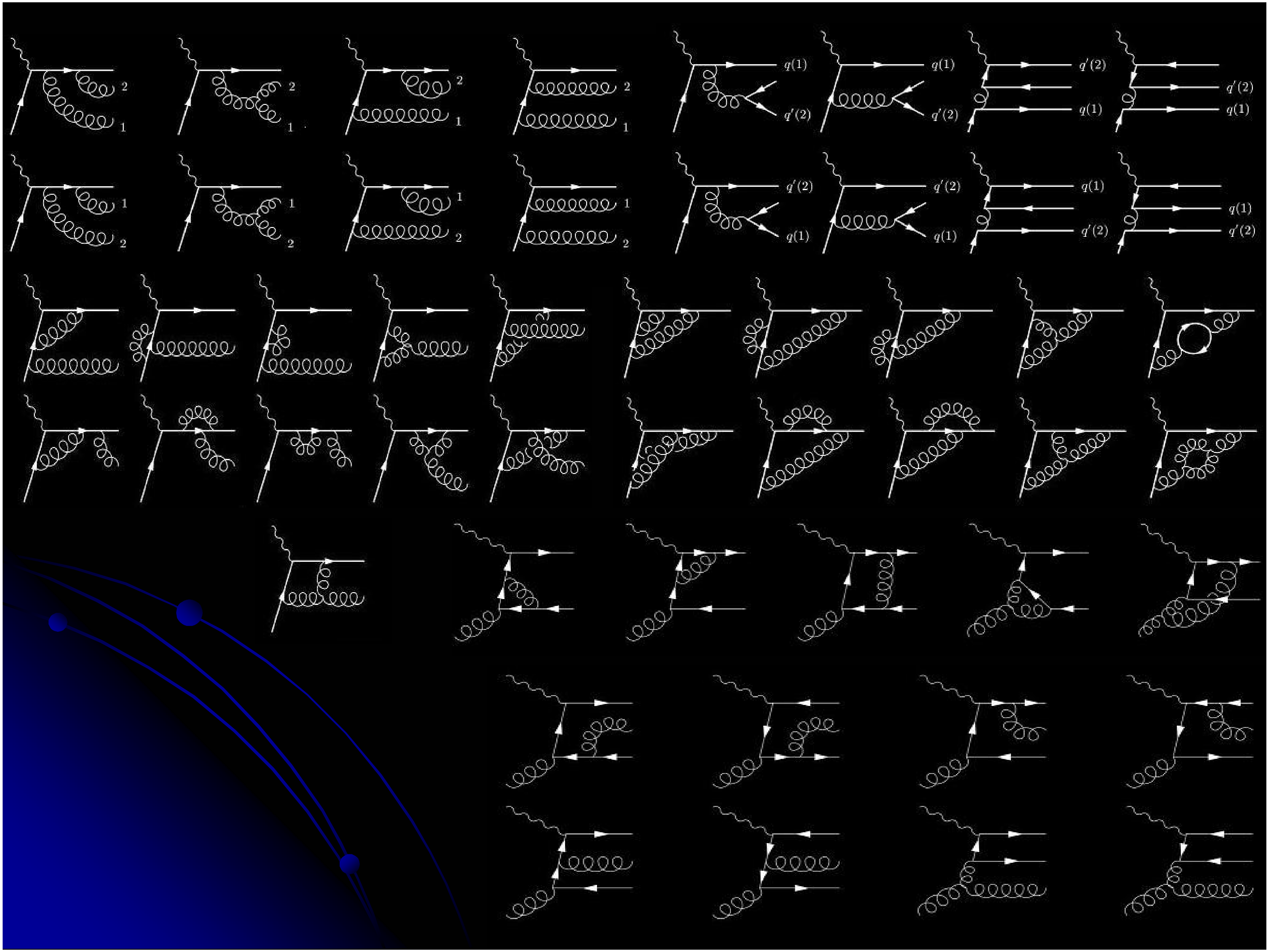
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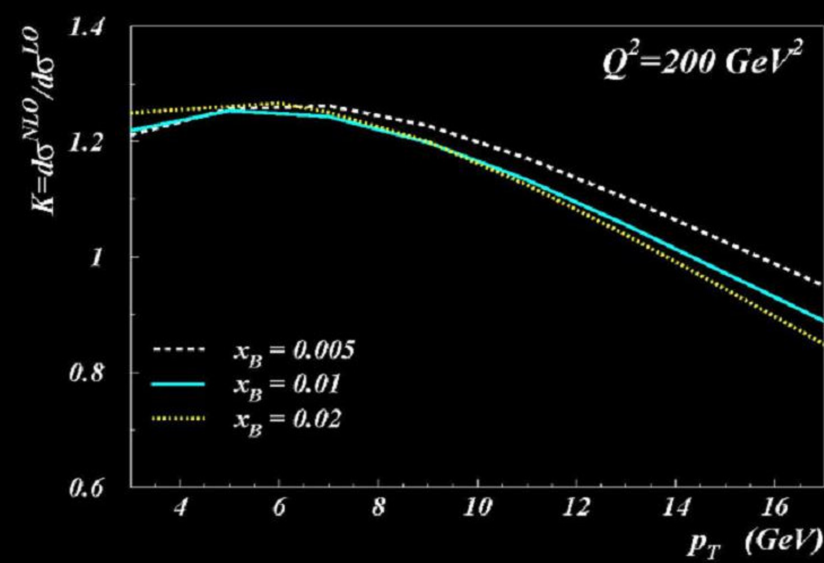

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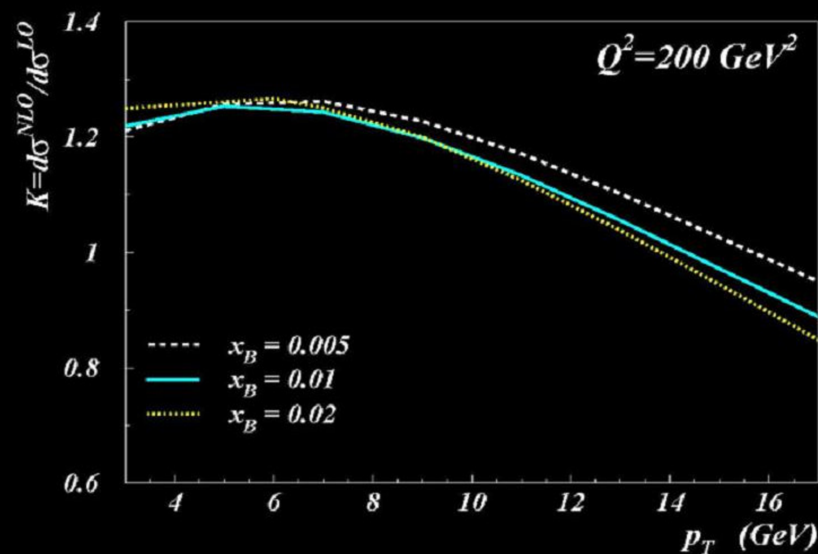

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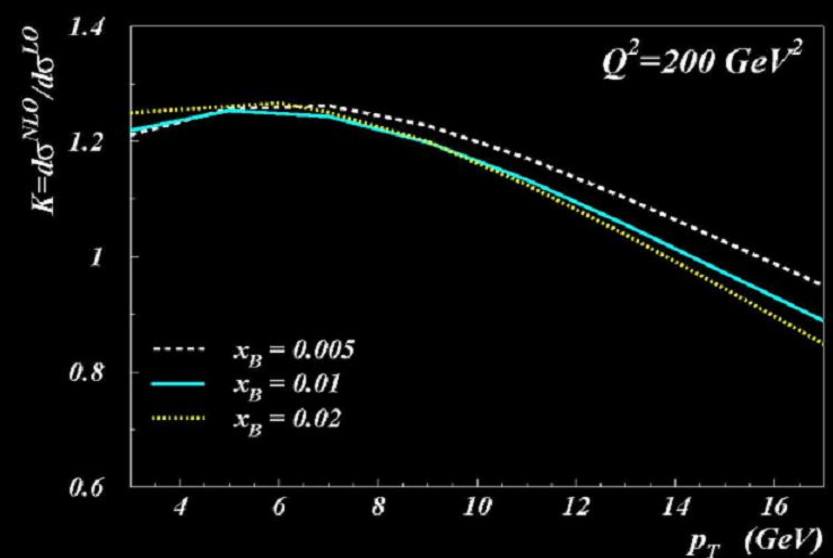

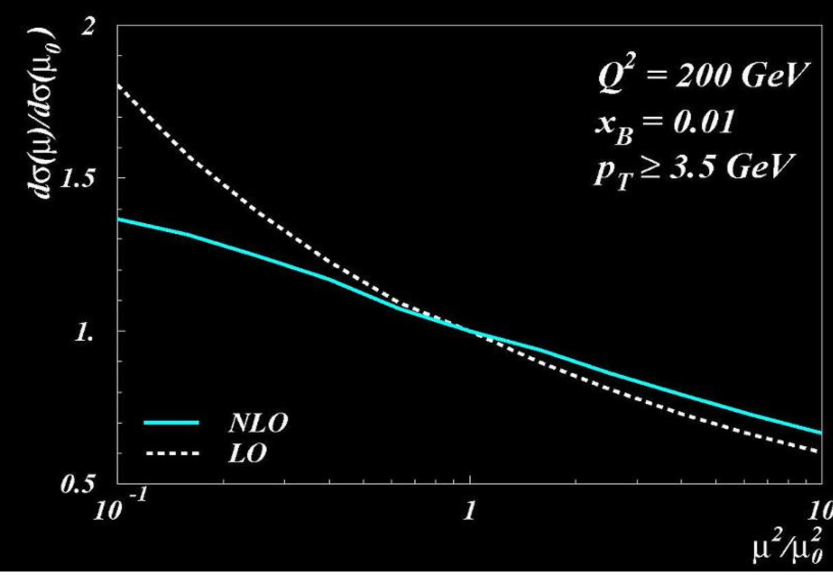

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A. Atkas et al. Eur.Phys.J.C36 (2004) 441,

e^+ @ 27.6 GeV, p @ 820 GeV

$2.5 < p_T < 15$ GeV

$\theta_\pi \in [5^o, 25^o]$

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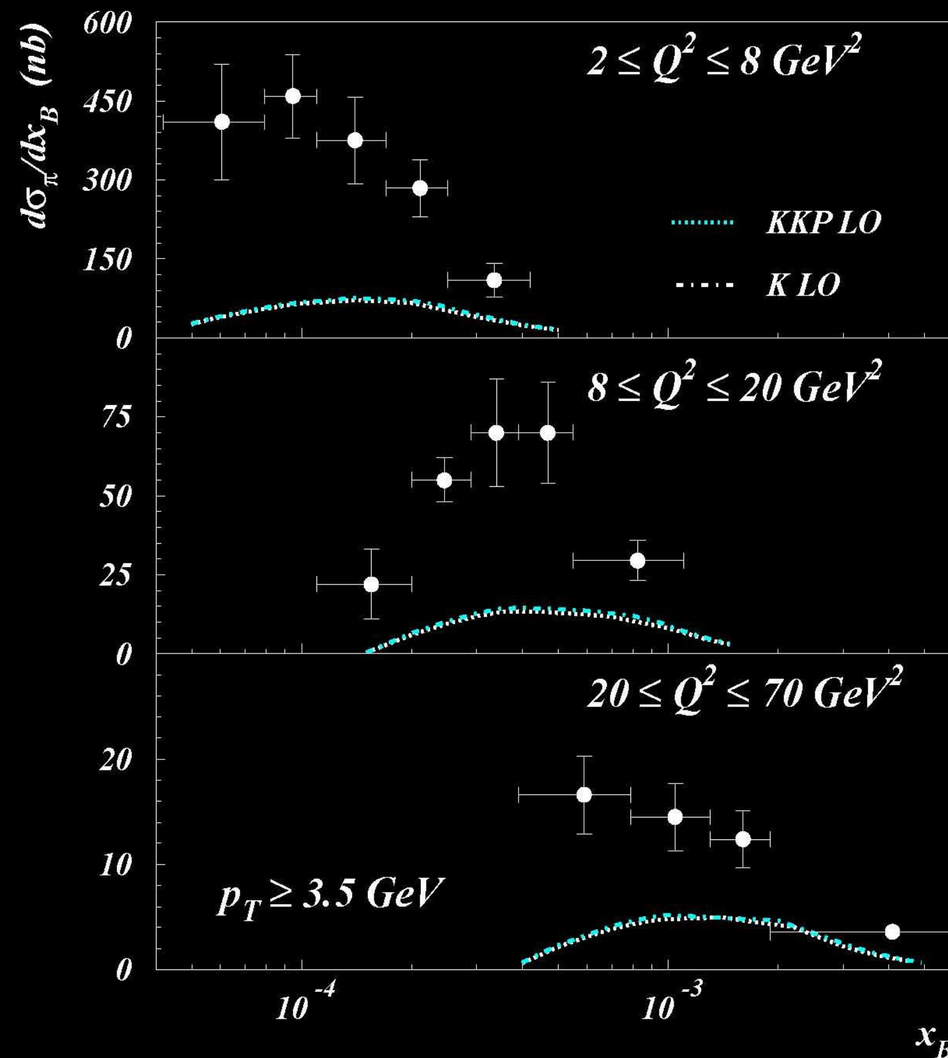

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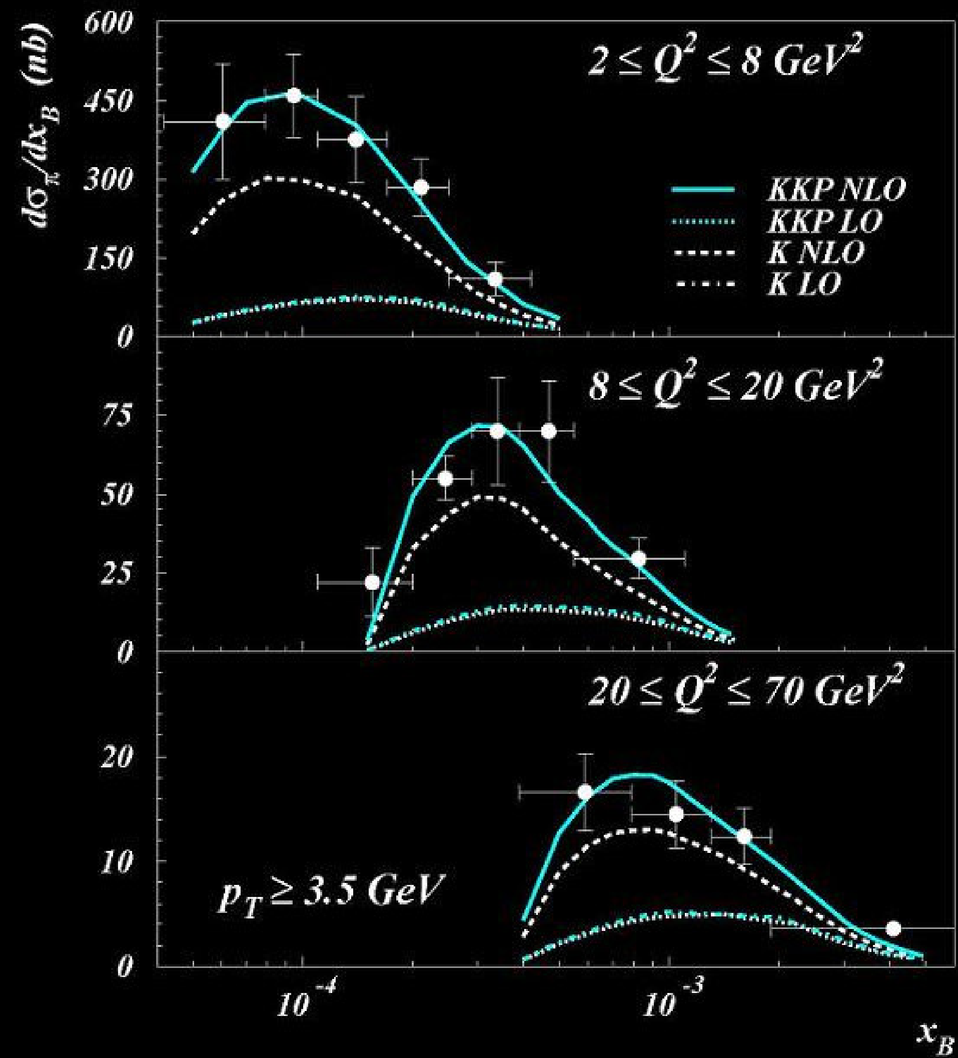

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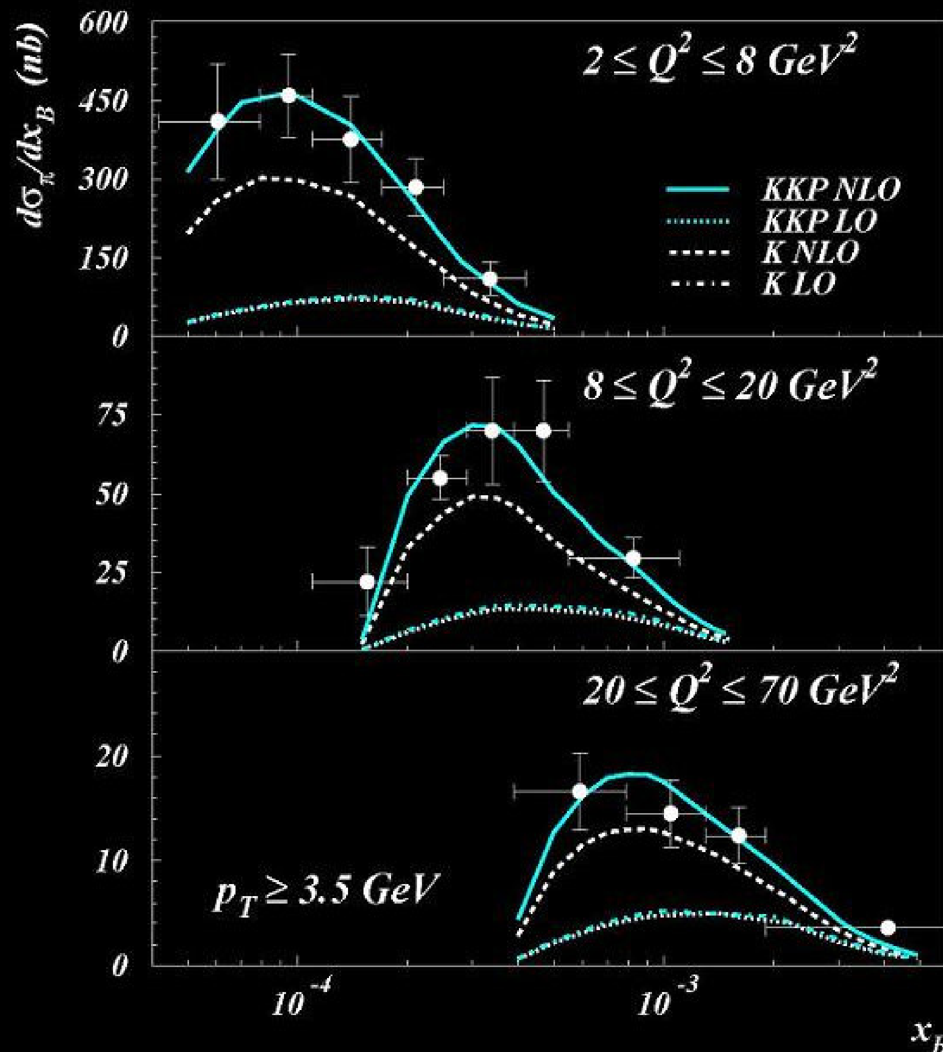

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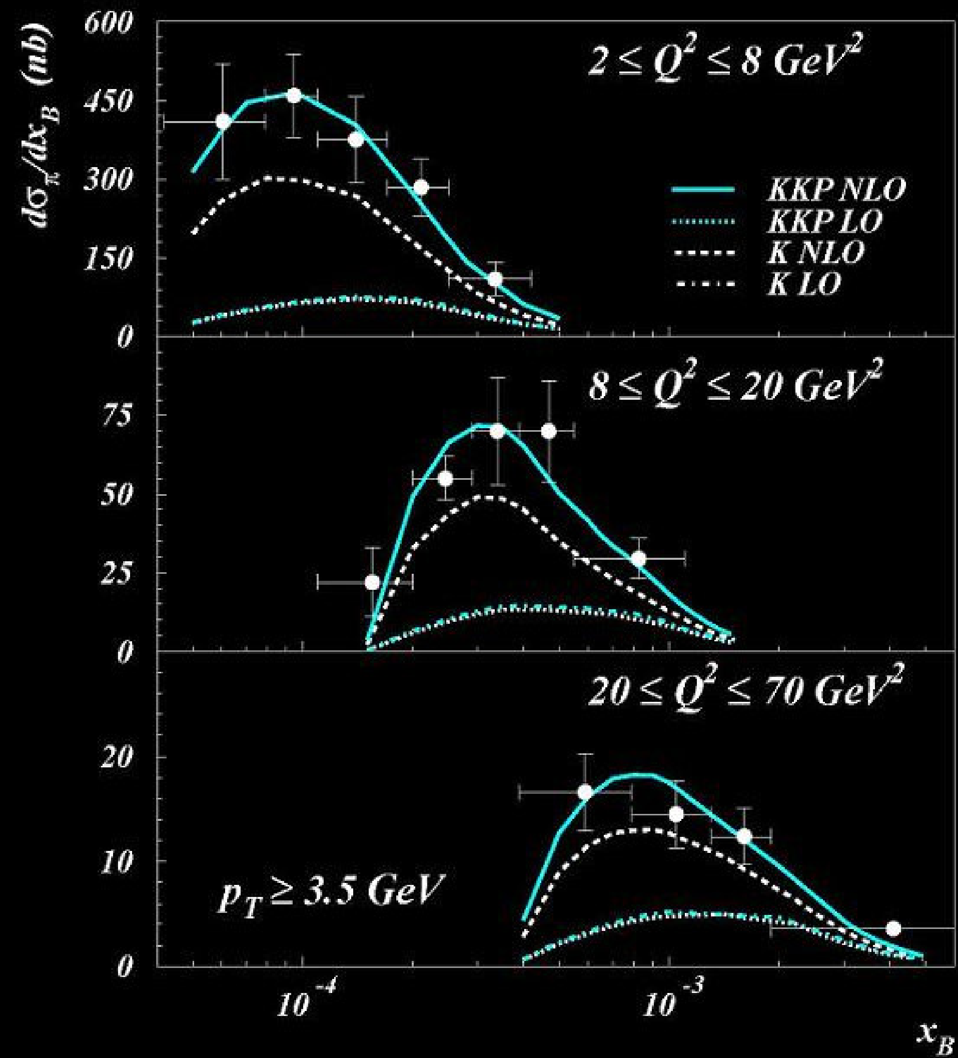

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- the choice for FFs matters

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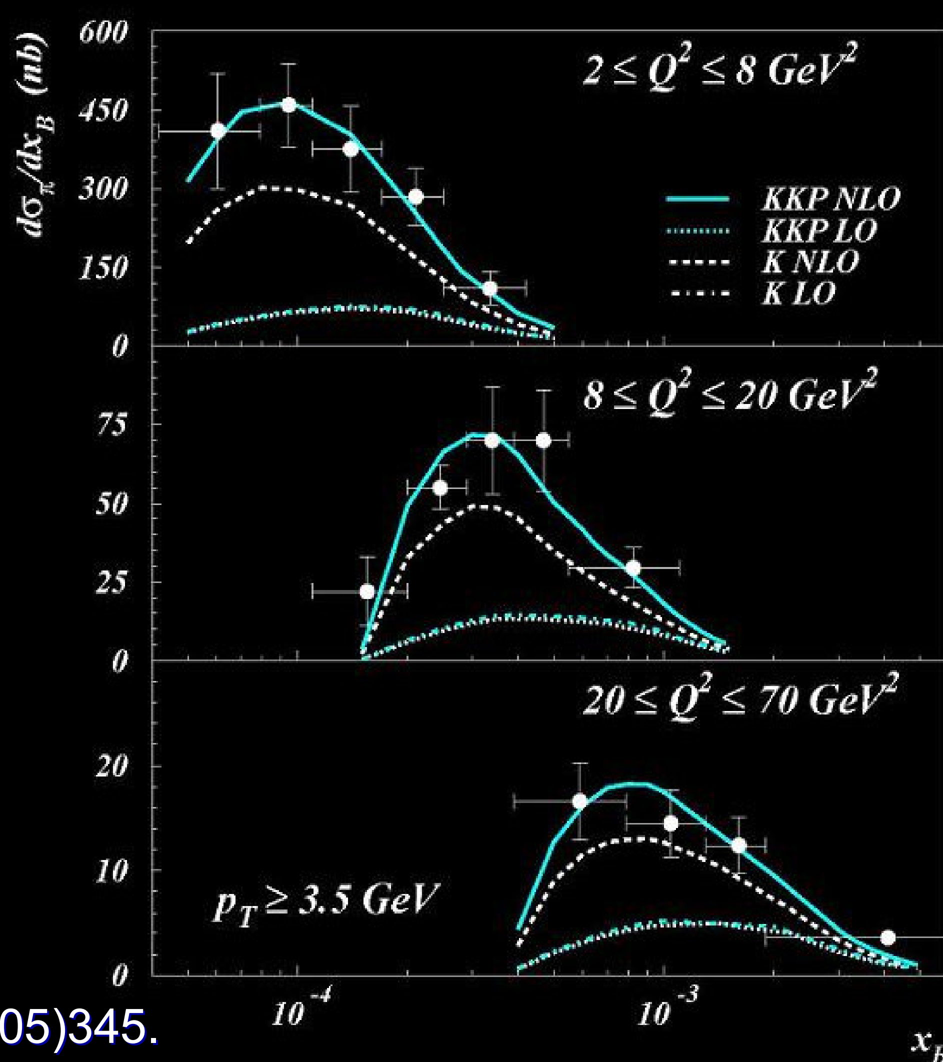
e^{+} @ 27.6 GeV, p @ 820 GeV

$2.5 < p_T < 15$ GeV

$\theta_\pi \in [5^o, 25^o]$

$x_\pi = E_\pi / E_p > 0.01$

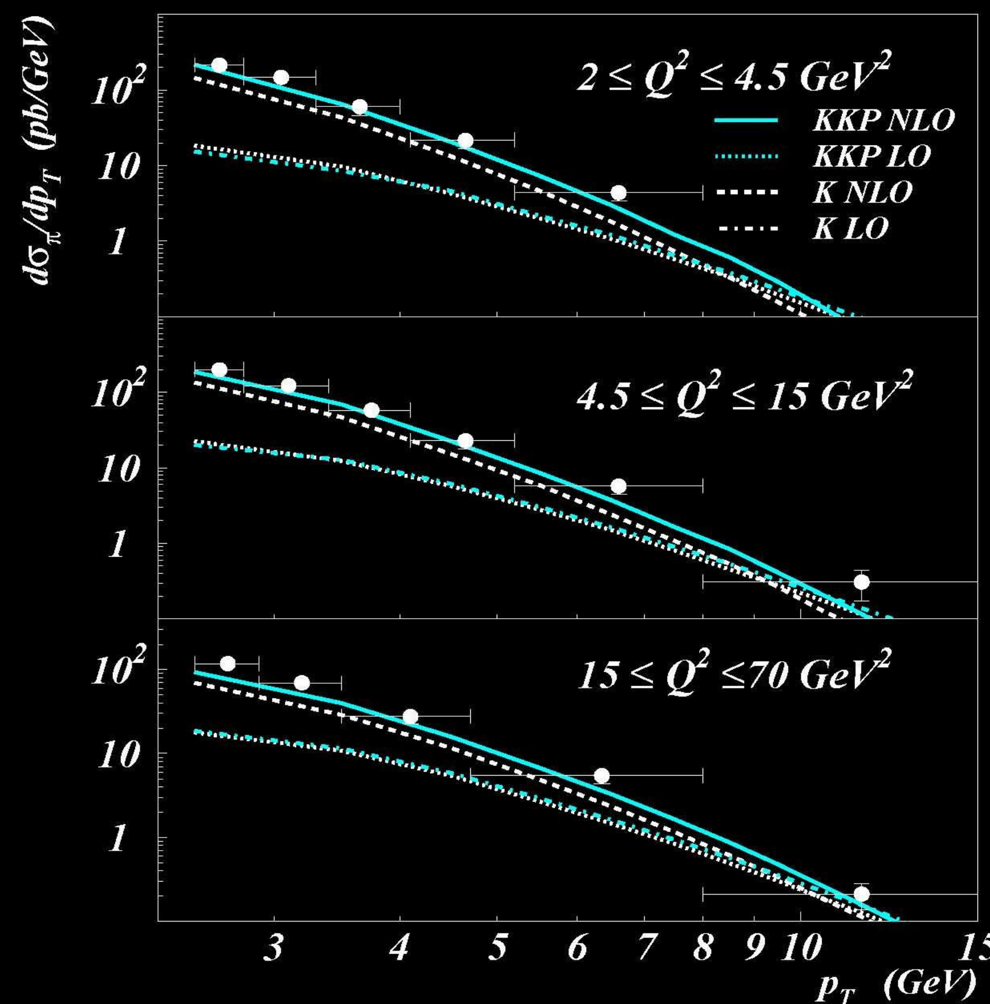
'K' S. Kretzer, Phys. Rev.D62 (2000) 0540001,
'KKP' B. A. Kniehl et al. Nucl.Phys.B582 (2000) 514.



- NLO effects are large!
- the choice for FFs matters

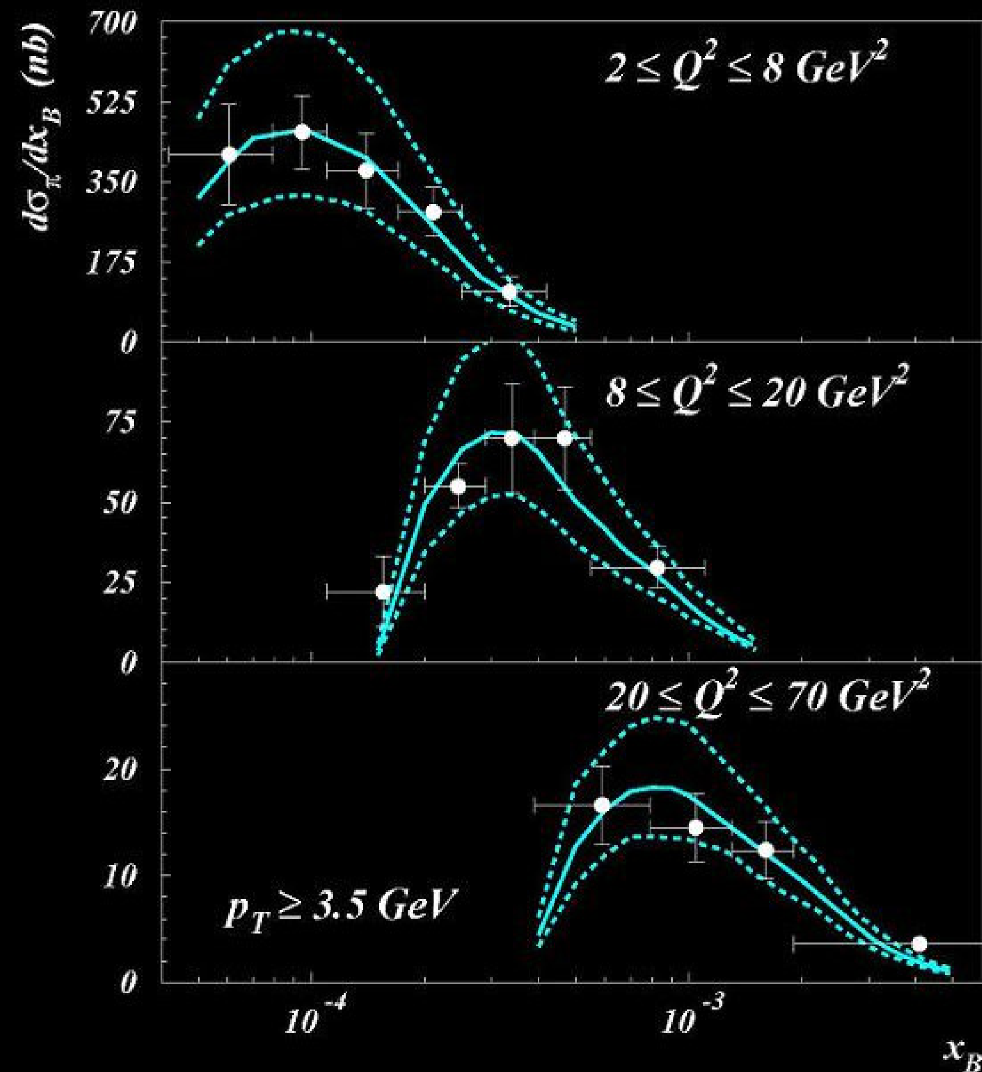
Similar conclusions by:
B. Kniehl et al. Nucl.Phys.B711 (2005)345.

Phenomenology III



Phenomenology IV:

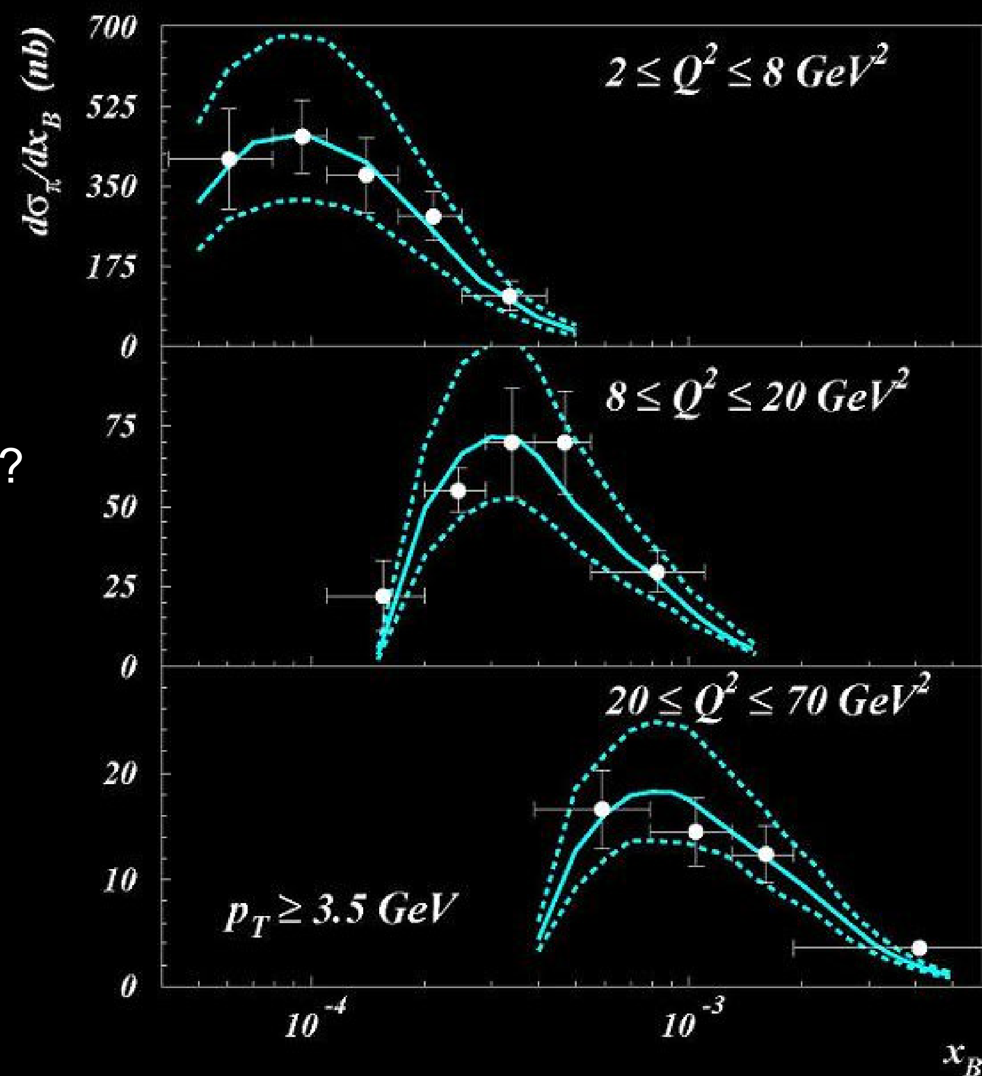
- factorization scale dependence



Phenomenology IV:

- factorization scale dependence

- significant corrections at next order?
  NNLO



Phenomenology V:

- why so large??

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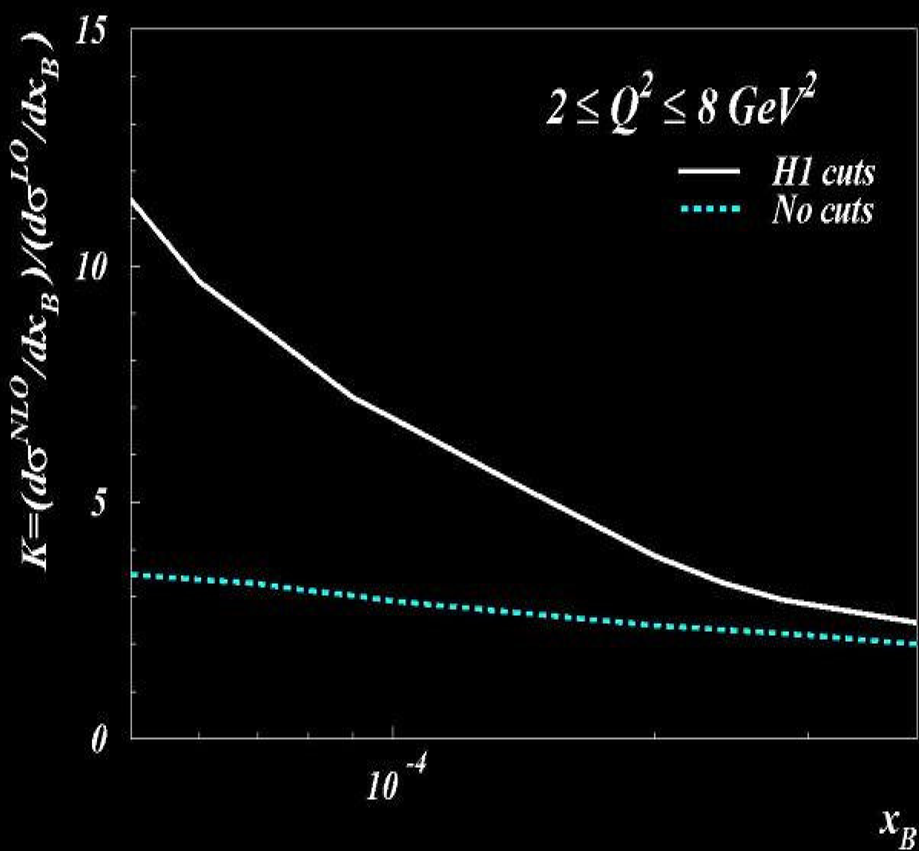
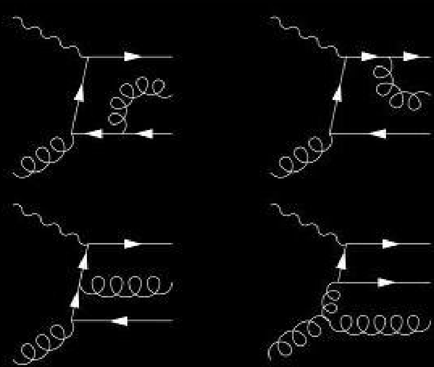
• why so large??

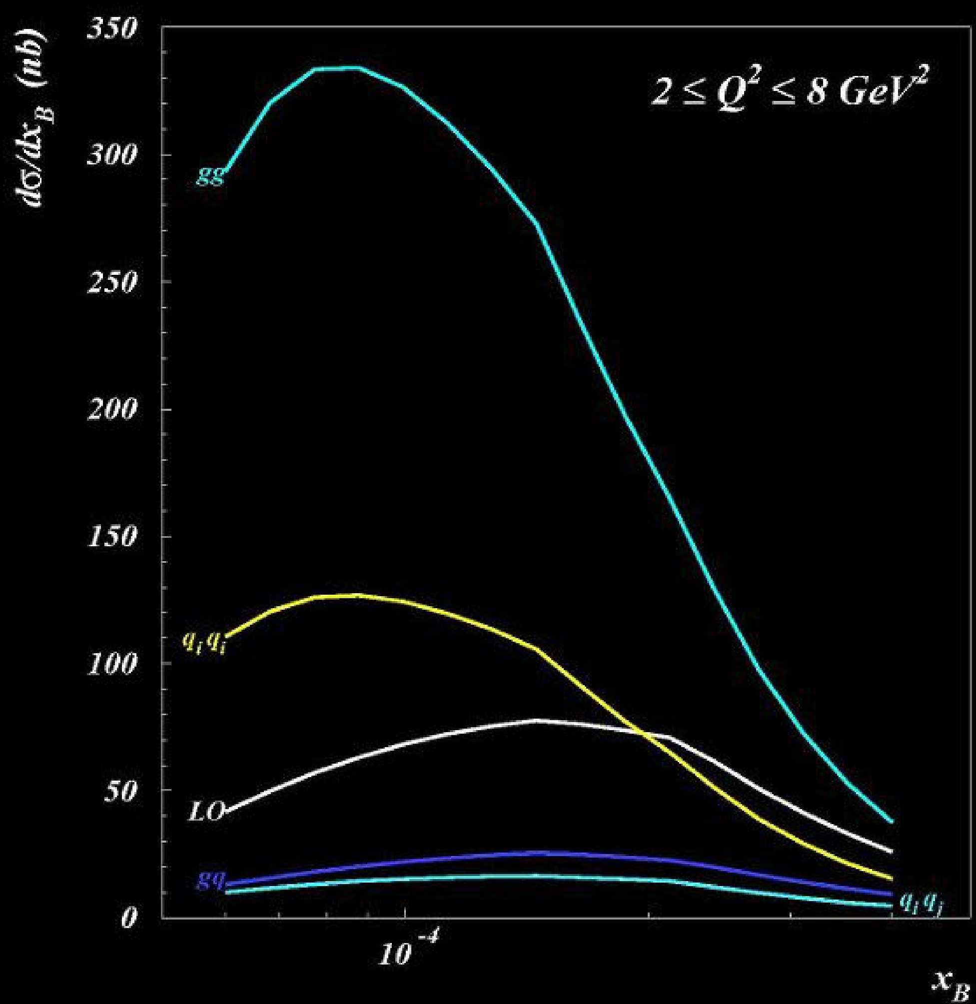


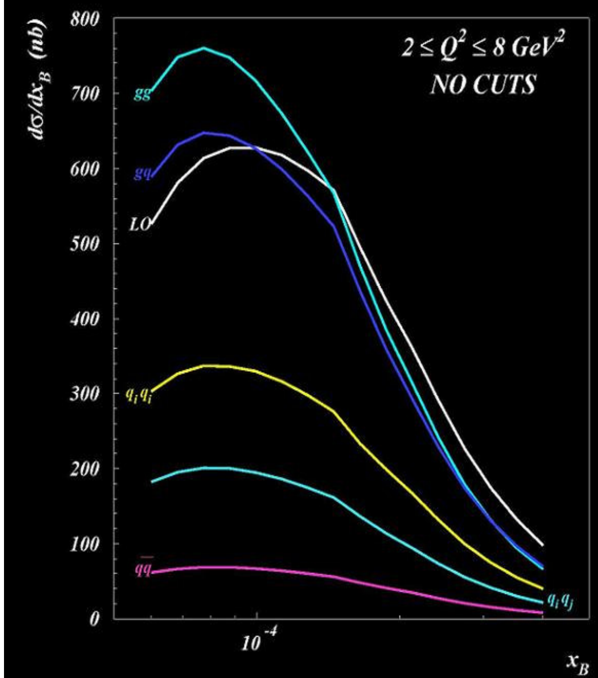
• effects from experimental cuts

Phenomenology VI:

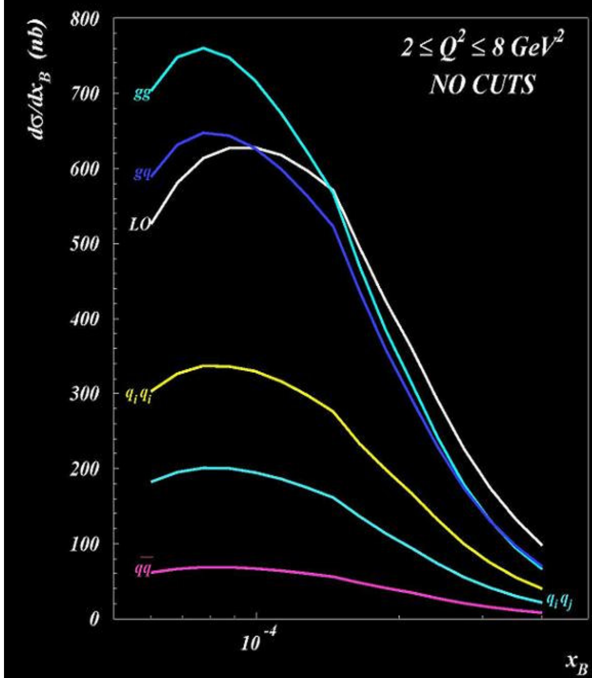
- "new" channel

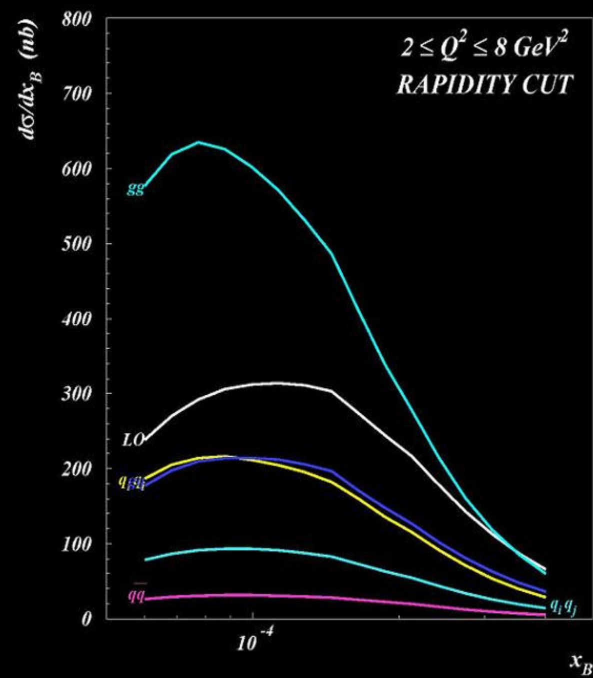





$d\sigma/dx_B$ (nb)
800
700
600
500
400
300
200
100
0
10^{-4}
x_B
$2 \leq Q^2 \leq 8\ GeV^2$
NO CUTS
gg
gq
LO
$q_i q_i$
$q\bar{q}$
$q_i q_j$

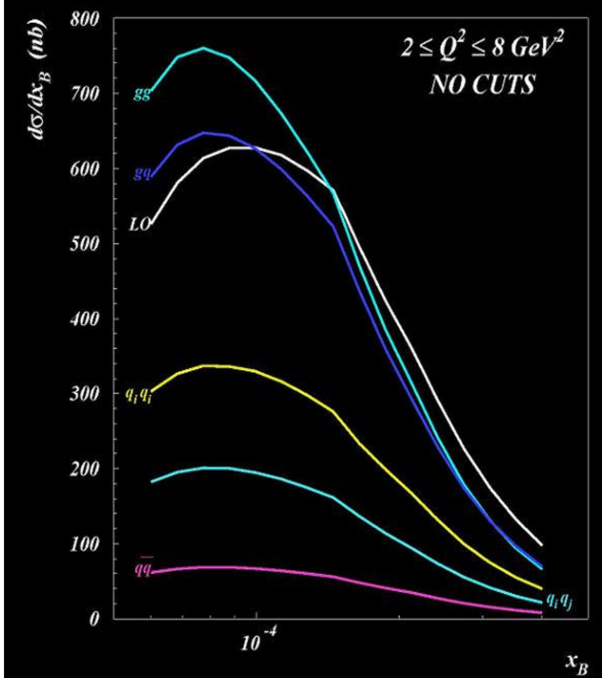
no cuts

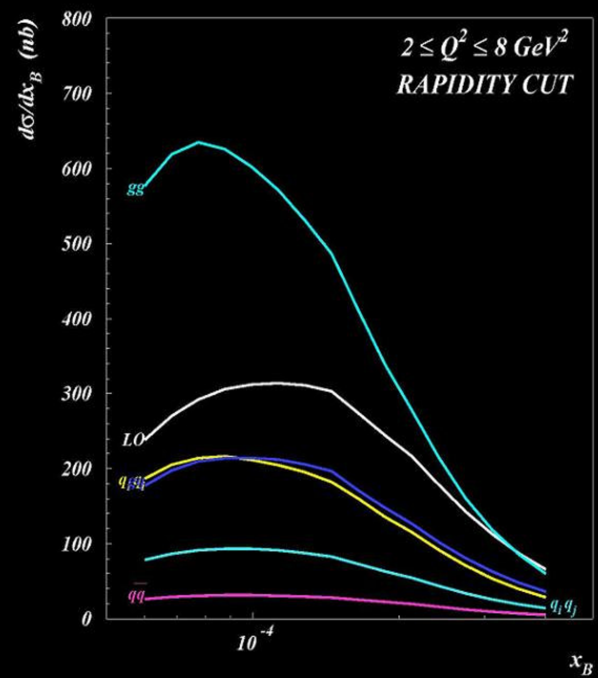


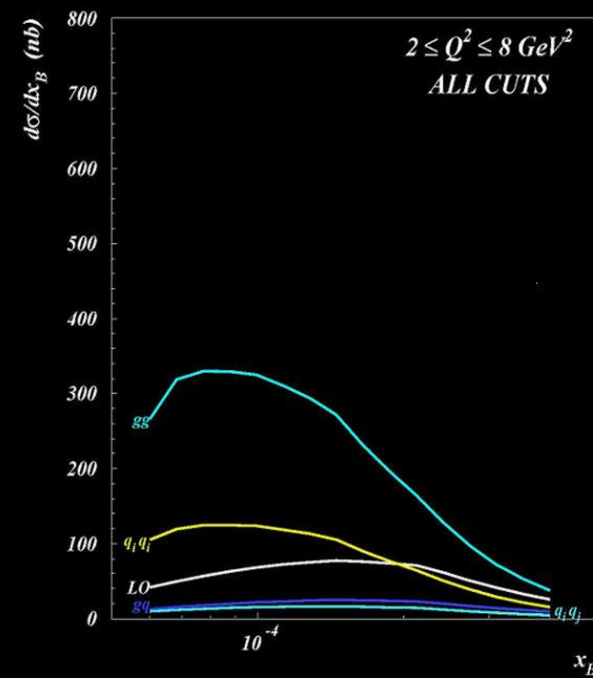


no cuts

rapidity cuts







no cuts

rapidity cuts

all cuts

Conclusions:

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- DGLAP in good health (within present uncertainties)