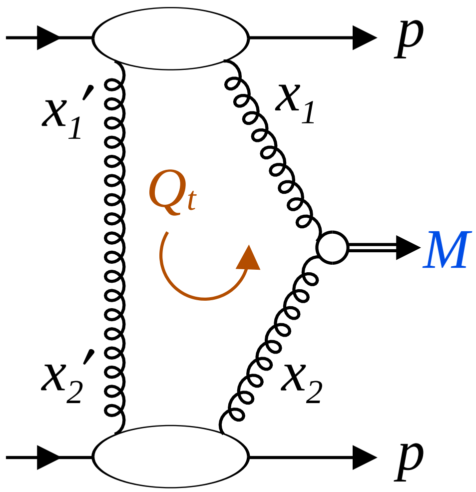
LUND UNIVERSITY

Central Exclusive Higgs with LDC uPDFs

- Higgs à la Khoze, Martin, Ryskin
- Unintegrated gluons from LDC
- Preliminary results

Fermilab
2003.09.20
Leif Lönnblad

Exclusive Diffractive Higgs



$$\frac{d\sigma_M^{\text{excl}}}{dM^2dy} = \frac{d\mathcal{L}}{dM^2dy}\hat{\sigma}_{gg\to M}(M^2)$$

$$M^2\frac{d\mathcal{L}}{dM^2dy} = S^2L$$

$$L = S^2\left(\frac{\pi}{(N_c^2-1)b}\int\frac{dQ_t^2}{Q_t^4}f_g(x_1,x_1',Q_t^2,M^2/4)f_g(x_2,x_2',Q_t^2,M^2/4)\right)^2$$

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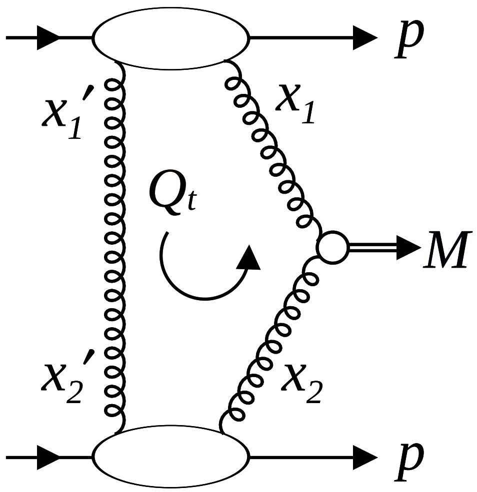

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f_g is the un-integrated, off-diagonal gluon density.

S^2 is a soft survival probability.

b is the t-slope of the proton.

For $x' \approx \frac{Q_t}{\sqrt{s}} \ll x \approx \frac{M}{\sqrt{s}} \ll 1$:

$$f_g(x, x', Q_t^2, M^2/4) = R_g \frac{\delta}{\delta Q_t^2}\left[\sqrt{T(Q_t, M/2) xg(x, Q_t^2)}\right]$$

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$R_g(x, \mu^2) \approx 1 + (0.82 + 0.56\lambda)\lambda$
with $\quad \lambda = d\ln(xg(x, \mu^2))/d\ln(1/x)$

$\langle R_g \rangle \approx 1.2(1.4)$ at LHC (Tevatron)

T is the Sudakov form factor (hard survival probability).

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Gap survival probability due to soft/semi-hard rescatterings $S^2 \approx 0.02(0.045)$ for the LHC (Tevatron)

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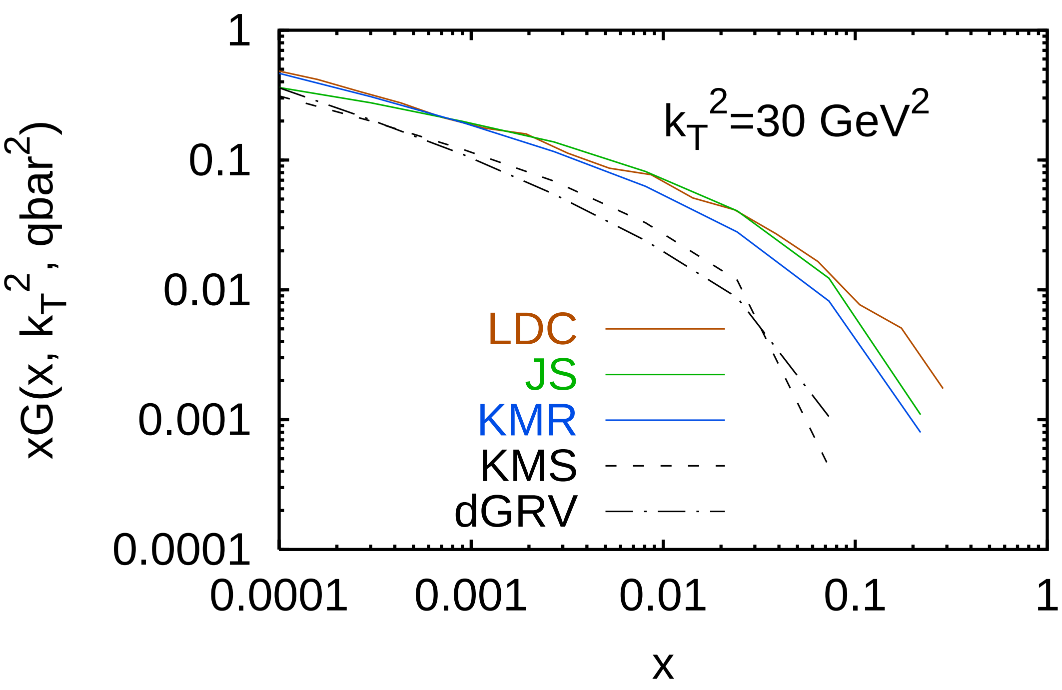
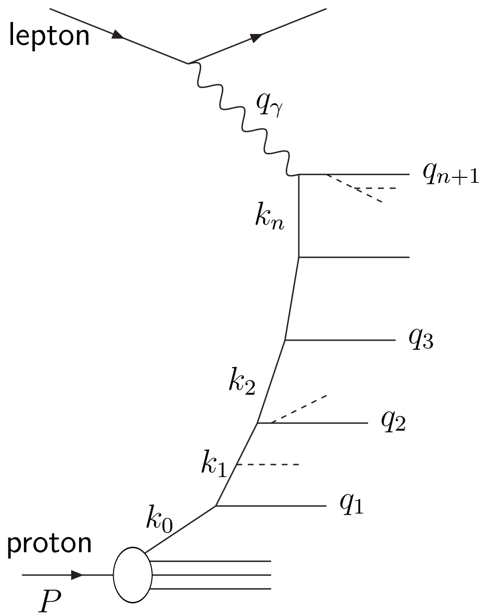


Linked Dipole Chain Model



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$$\mathcal{G}(x, k_\perp^2, \bar{q}^2) \approx \mathcal{G}(x, k_\perp^2, k_\perp^2) \Delta_S(k_\perp^2, \bar{q}^2)$$

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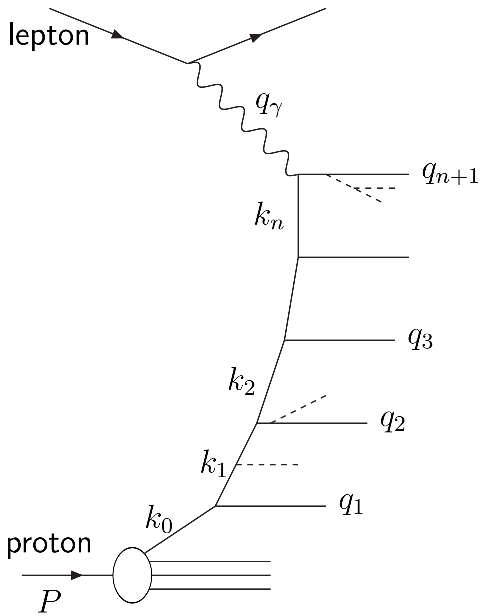

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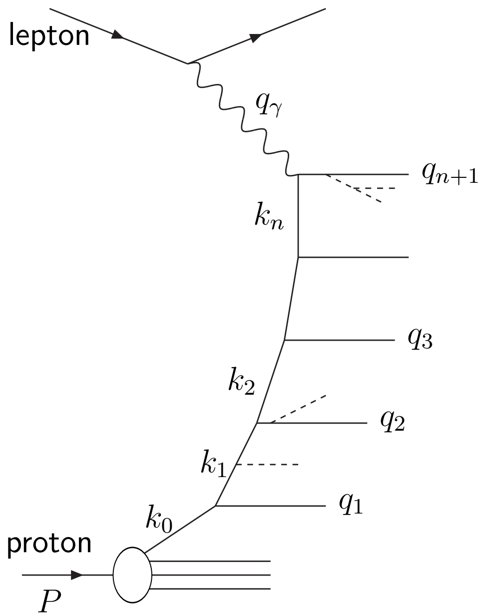

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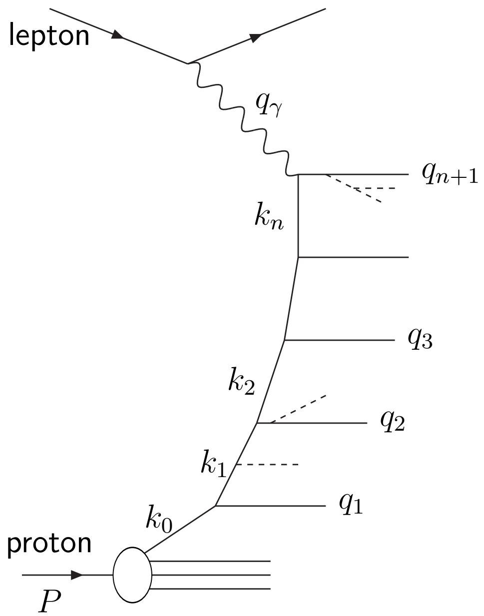

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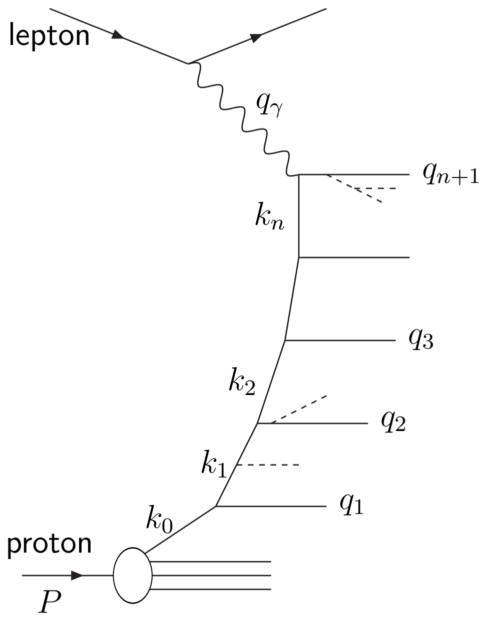

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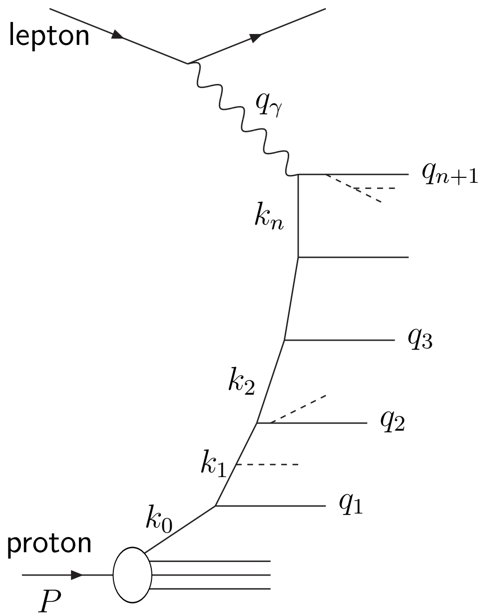

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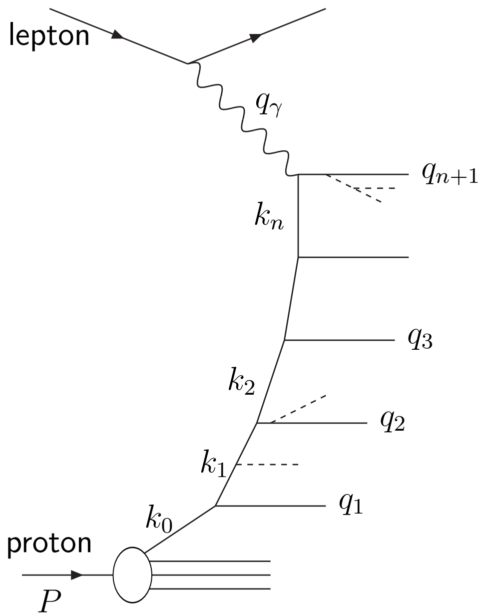

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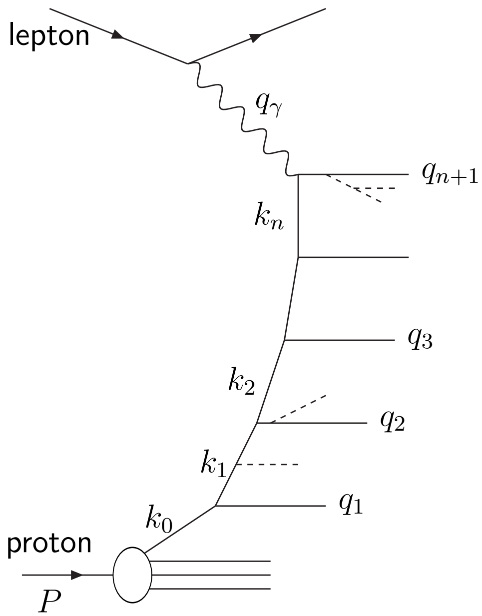

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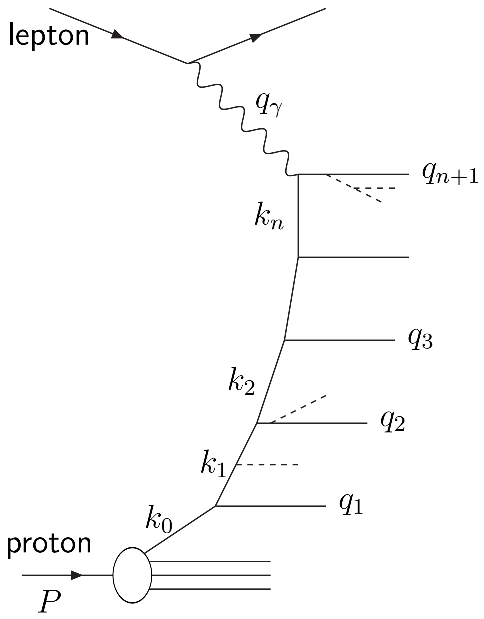

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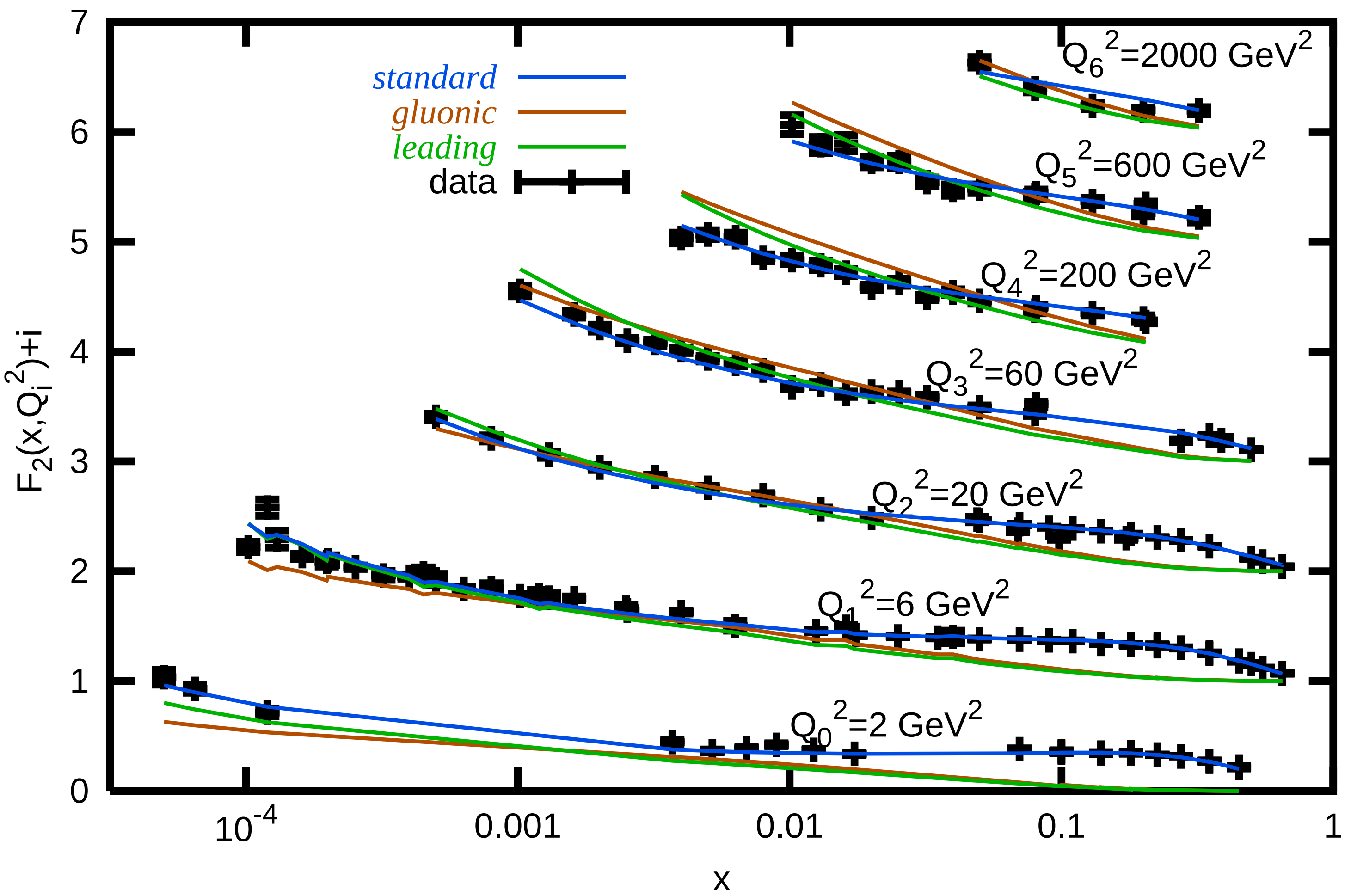
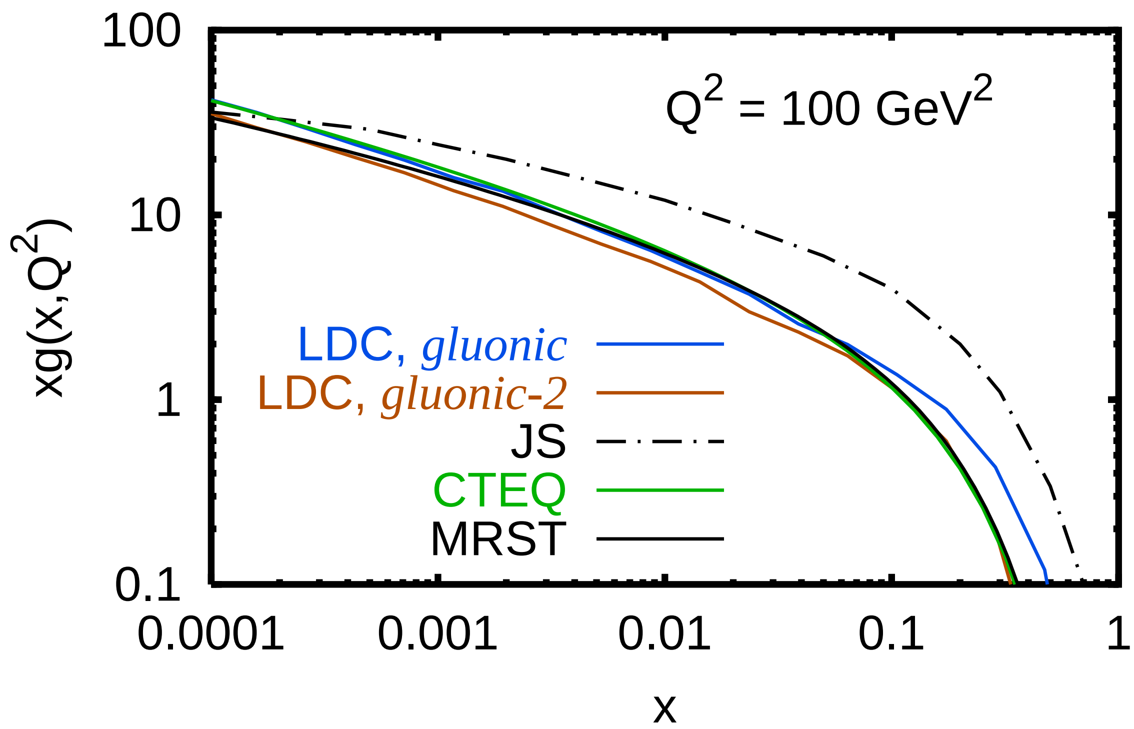
- Straight forward to add quarks
- and non-singular terms
- Forward–backward symmetric

$$\mathcal{G}(x, k_\perp^2, \bar{q}^2) \approx \mathcal{G}(x, k_\perp^2, k_\perp^2)\Delta_S(k_\perp^2, \bar{q}^2)$$



standard
gluonic
leading
data
Q_6^2=2000 GeV^2
Q_5^2=600 GeV^2
Q_4^2=200 GeV^2
Q_3^2=60 GeV^2
Q_2^2=20 GeV^2
Q_1^2=6 GeV^2
Q_0^2=2 GeV^2
$F_2(x,Q_i^2)$+i
x
0
1
2
3
4
5
6
7
10^{-4}
0.001
0.01
0.1
1



$$xg(x,Q^2) = \int_{k_{\perp 0}^2}^{Q^2} \frac{dk_\perp^2}{k_\perp^2}\mathcal{G}(x,k_\perp^2,Q) + \int_{Q^2}^{Q^2/x} \frac{dk_\perp^2}{k_\perp^2}\mathcal{G}(x\frac{k_\perp^2}{Q^2},k_\perp^2,Q)\frac{Q^2}{k_\perp^2}$$
$$+xg_0(x,k_{\perp 0}^2) \times \Delta_\mathrm{S}$$

$$f_g(x, x', Q_t^2, M^2/4) = R_g \frac{\delta}{\delta Q_t^2} \left[\sqrt{T(Q_t, M/2)} xg(x, Q_t^2) \right]$$

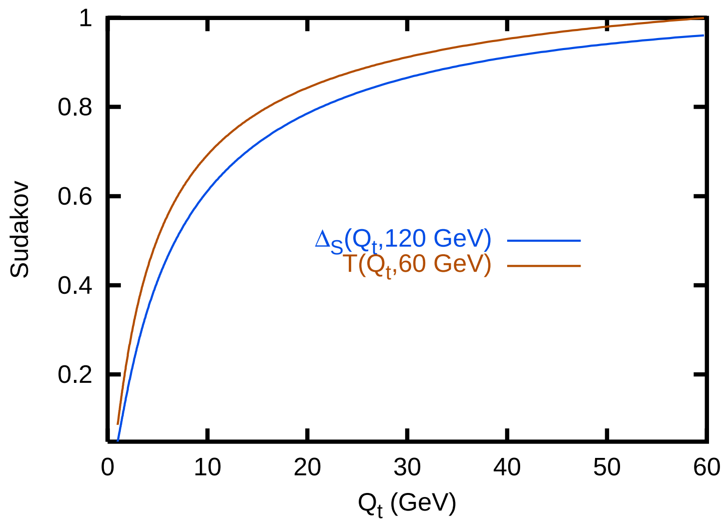
"Strictly speaking the relationship was only proven for integrated gluons. However, it is expected to hold equally well for the unintegrated distribution."

$$f_g(x, x', Q_t^2, M^2) = R_g \sqrt{\Delta_S(Q_t^2, M^2)}\, \mathcal{G}(x, Q_t^2, Q_t^2)$$

In LDC $\mathcal{G}(x, Q_t^2, Q_t^2)$ also contains effects of emissions with $p_{\perp g} > Q_t$. Should these be included? Also the screening gluon may contain effects of $p_{\perp g} > Q_t$ which are larger since $x' \approx \frac{Q_t}{\sqrt{s}} \ll x \approx \frac{M}{\sqrt{s}}$.

$$\ln T(Q_t, M/2) = -\int_{Q_t^2}^{M^2/4} \frac{\alpha_{\mathrm{s}}(k_\perp^2)}{2\pi} \frac{dk_\perp^2}{k_\perp^2} \int_0^{\frac{M}{M+2k_\perp}} \left[zP_{gg}(z) + n_f P_{qg}(z)\right] dz$$

$$\ln \Delta_S(Q_t^2, M^2) = -\int_{Q_t^2}^{M^2} \frac{\alpha_{\mathrm{s}}(k_\perp^2)}{2\pi} \frac{dk_\perp^2}{k_\perp^2} \int_0^{1-k_\perp/M} \left[zP_{gg}(z) + n_f P_{qg}(z)\right] dz$$



LDC needs a cutoff, $k_{\perp 0}$, below that we use non-perturbative input densities.

$$L = \left[\frac{\pi}{(N_c^2 - 1)b} \left(\int_{k_{\perp 0}^2}^{M^2} \frac{dQ_t^2}{Q_t^4} \mathcal{G}(x, Q_t^2, Q_t^2) \mathcal{G}(x, Q_t^2, Q_t^2) \Delta_S(Q_t^2, M^2) \right.\right.$$
$$\left.\left. + \; g_0(x, k_{\perp 0}^2) g_0(x, k_{\perp 0}^2) \Delta_S(k_{\perp 0}^2, M^2)/k_{\perp 0}^2 \right) \right]^2$$

We will use three different LDC unintegrated gluons which differs in the treatment of non-leading terms.

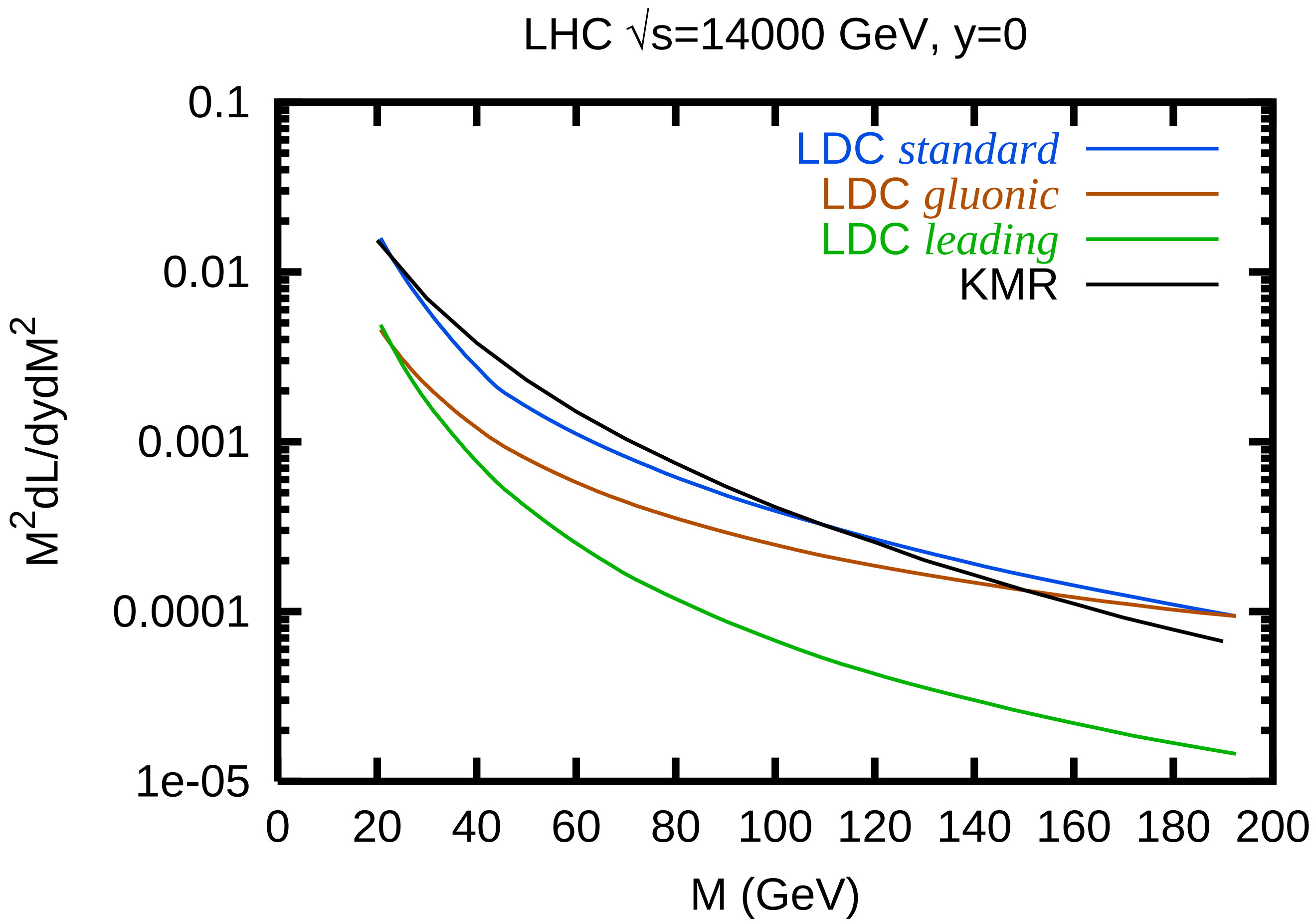
standard uses quark and gluon evolution with full splitting functions. Gives a good description of F_2.

gluonic uses only gluons with full splitting function. Gives a good description of the integrated gluon.

leading uses only gluons with only singular terms in the splitting function. Gives a good description of forward jets and b-production at the Tevatron.

They are all extracted from generating a large number of DIS events with LDCMC and sampling the gluon density in bins of x and $k_\perp$.

Preliminary results



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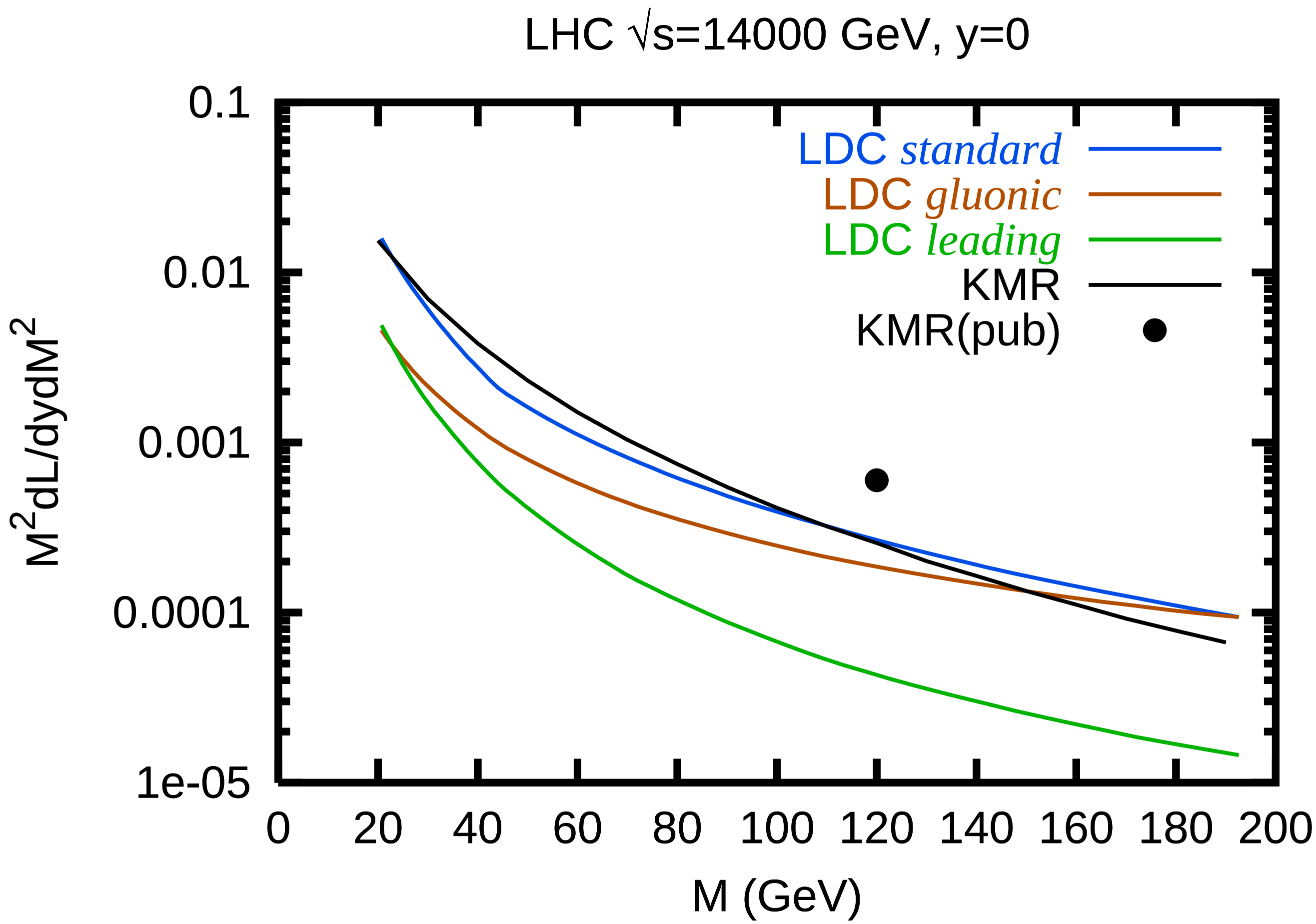
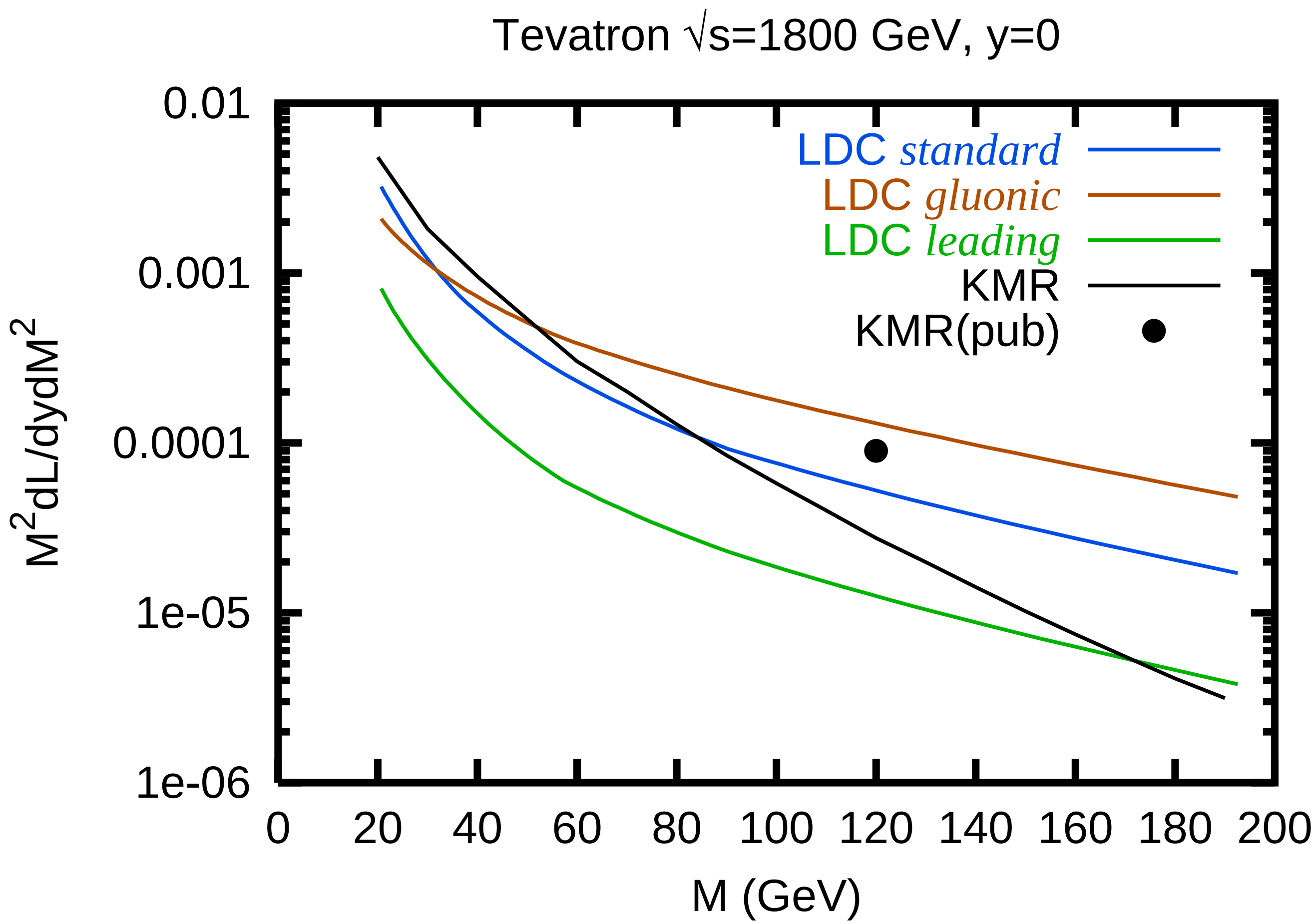
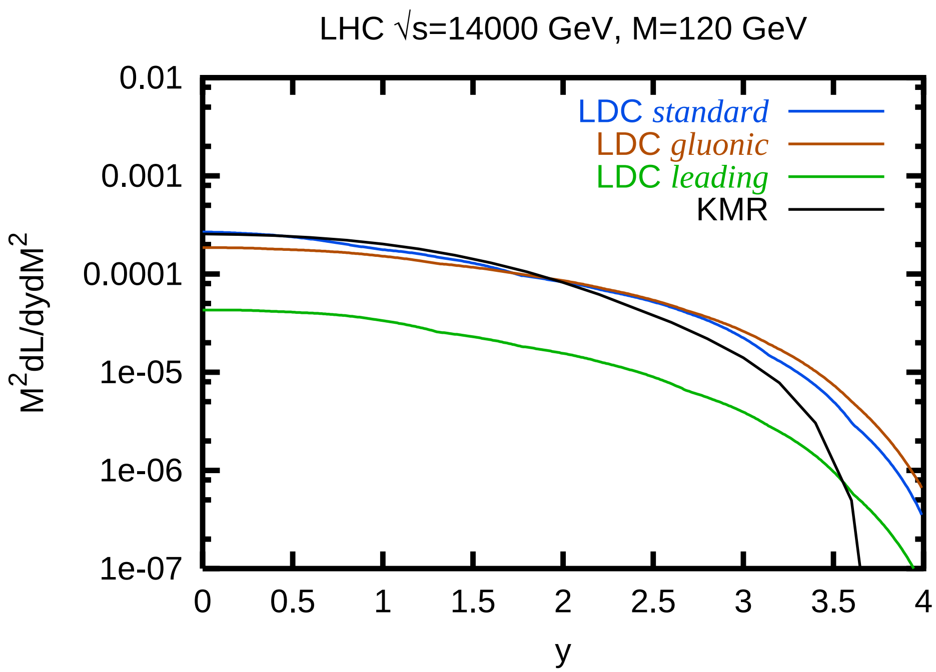
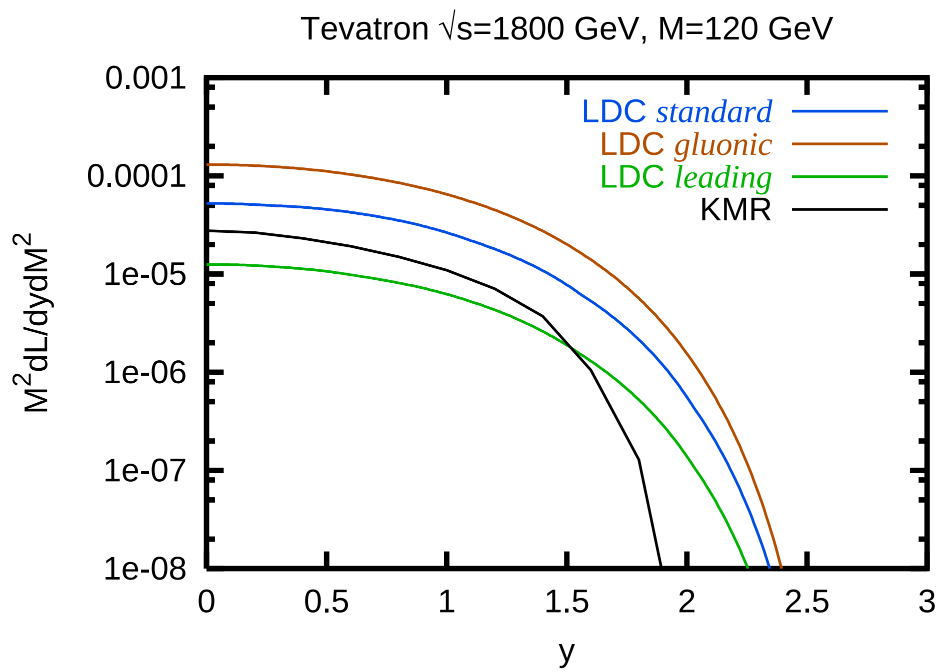


Khoze, Martin, Ryskin, *Eur. Phys. J.* **C23** (2002) 311.



Tevatron √s=1800 GeV, y=0
0.01
0.001
0.0001
1e-05
1e-06
0
20
40
60
80
100
120
140
160
180
200
M (GeV)
M2dL/dydM2
LDC standard
LDC gluonic
LDC leading
KMR
KMR(pub)


LHC √s=14000 GeV, M=120 GeV
LDC standard
LDC gluonic
LDC leading
KMR
M²dL/dydM²
0.01
0.001
0.0001
1e-05
1e-06
1e-07
0
0.5
1
1.5
2
2.5
3
3.5
4
y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LDC standard
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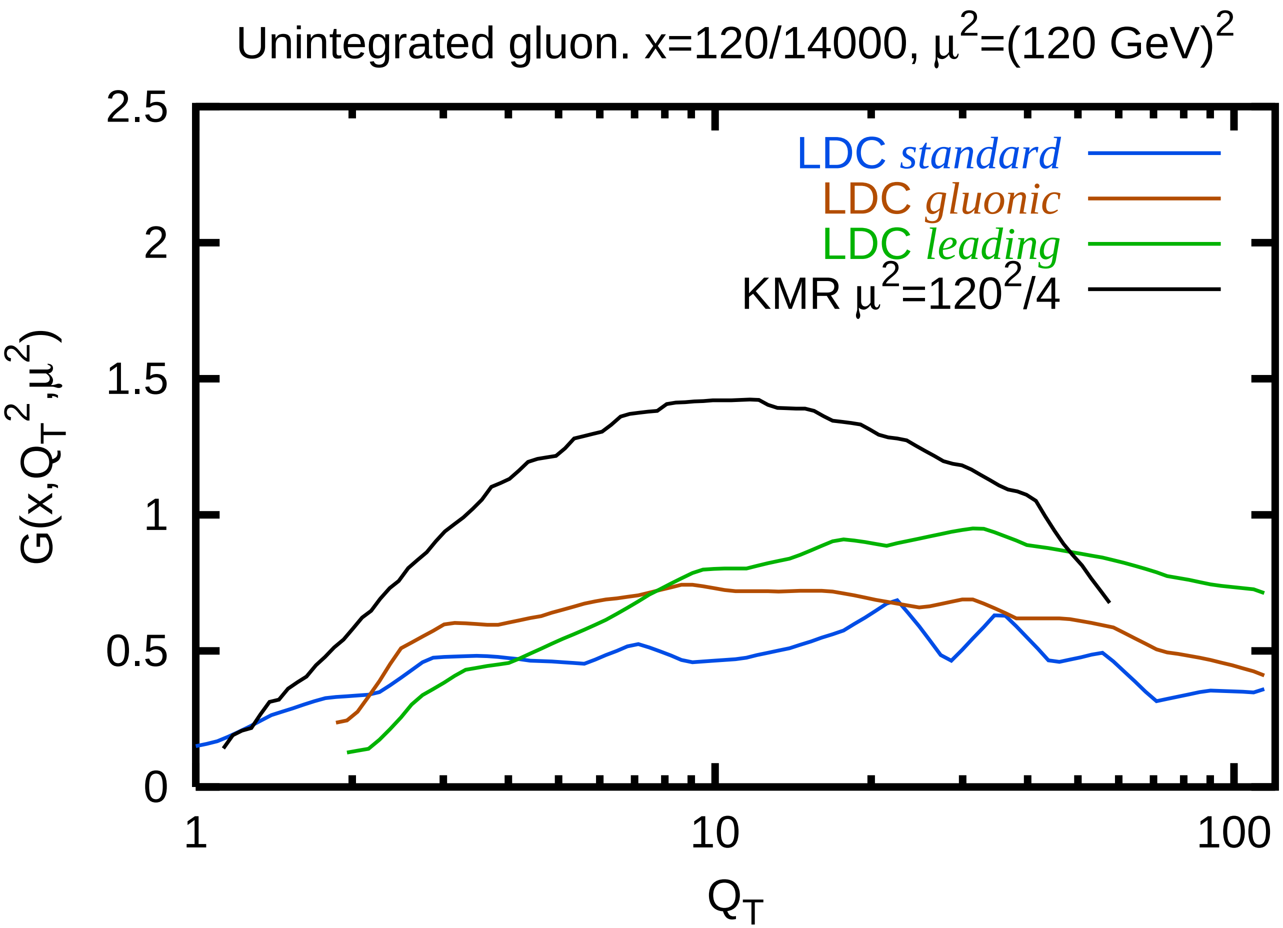
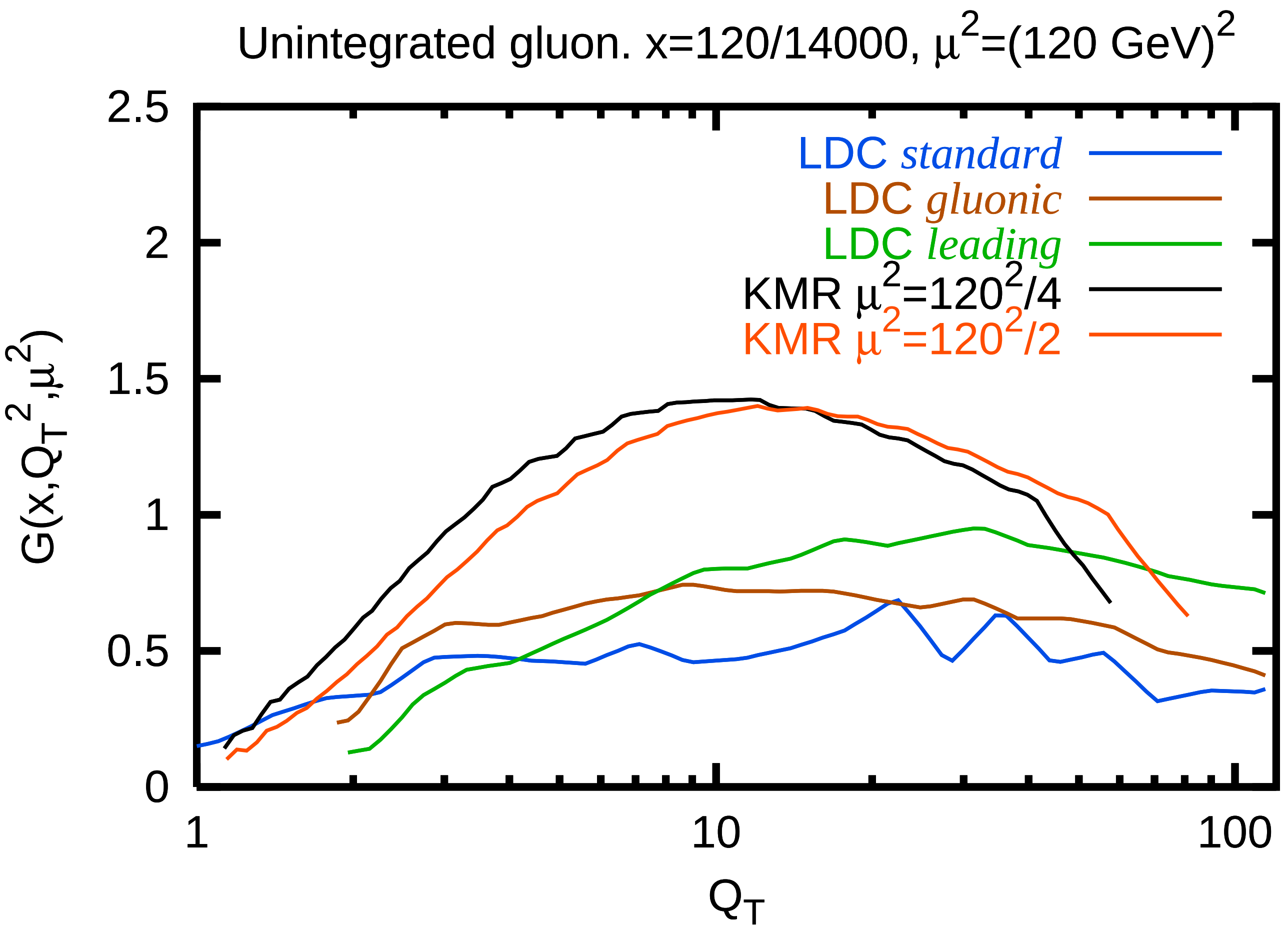
1e-08
0
0.5
1
1.5
2
2.5
3
y



In the luminosity function the Sudakov hits you at small Q_T and the $1/Q_T^4$ at large. $\langle Q_T \rangle \approx 2 - 3$ GeV.



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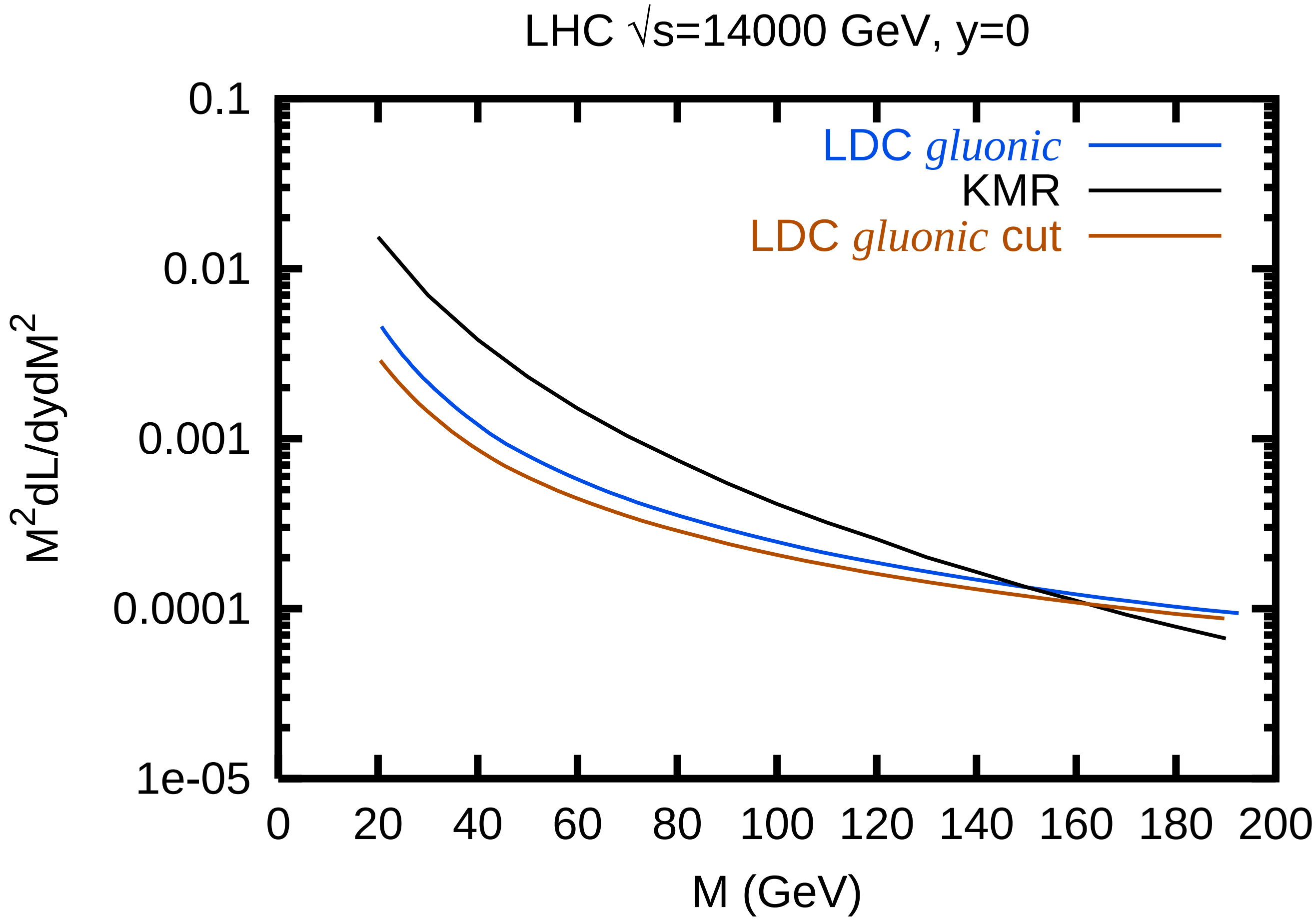
LHC √s=14000 GeV, y=0
LDC gluonic
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M2dL/dydM2
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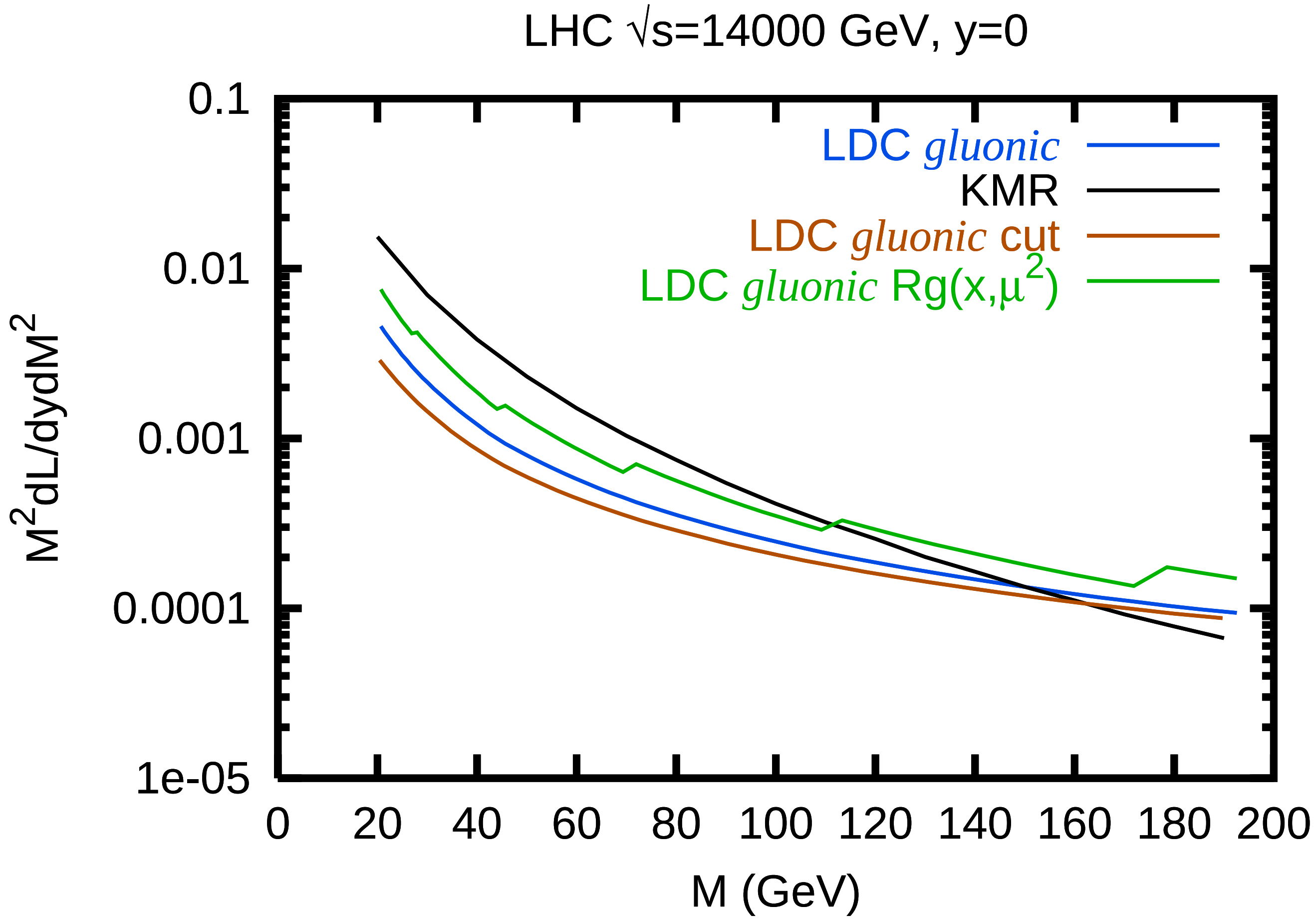

LHC √s=14000 GeV, y=0
LDC gluonic
KMR
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LDC gluonic Rg(x,μ2)
M2dL/dydM2
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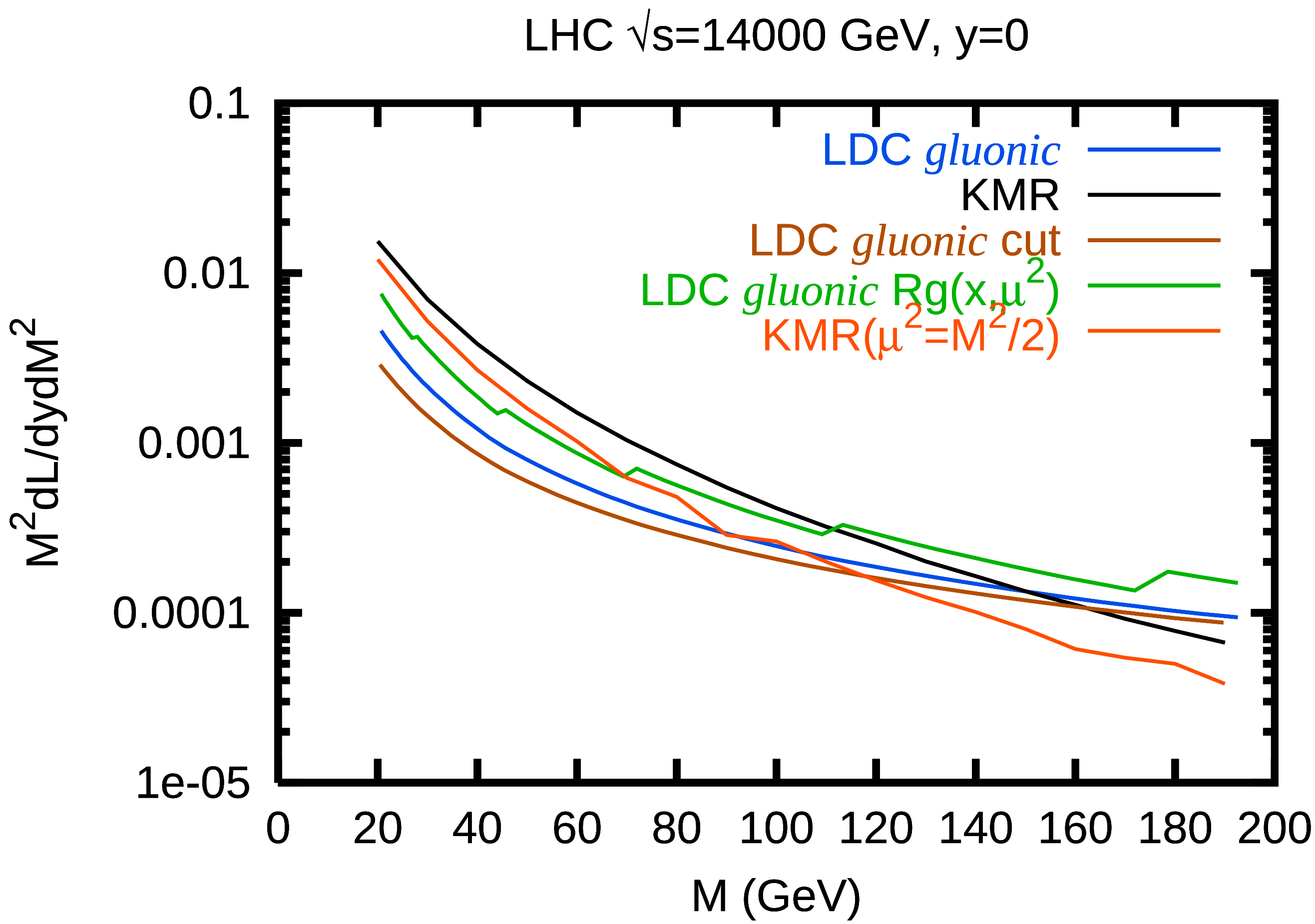
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KMR
LDC gluonic cut
LDC gluonic Rg(x,μ2)
KMR(μ2=M2/2)
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M2dL/dydM2
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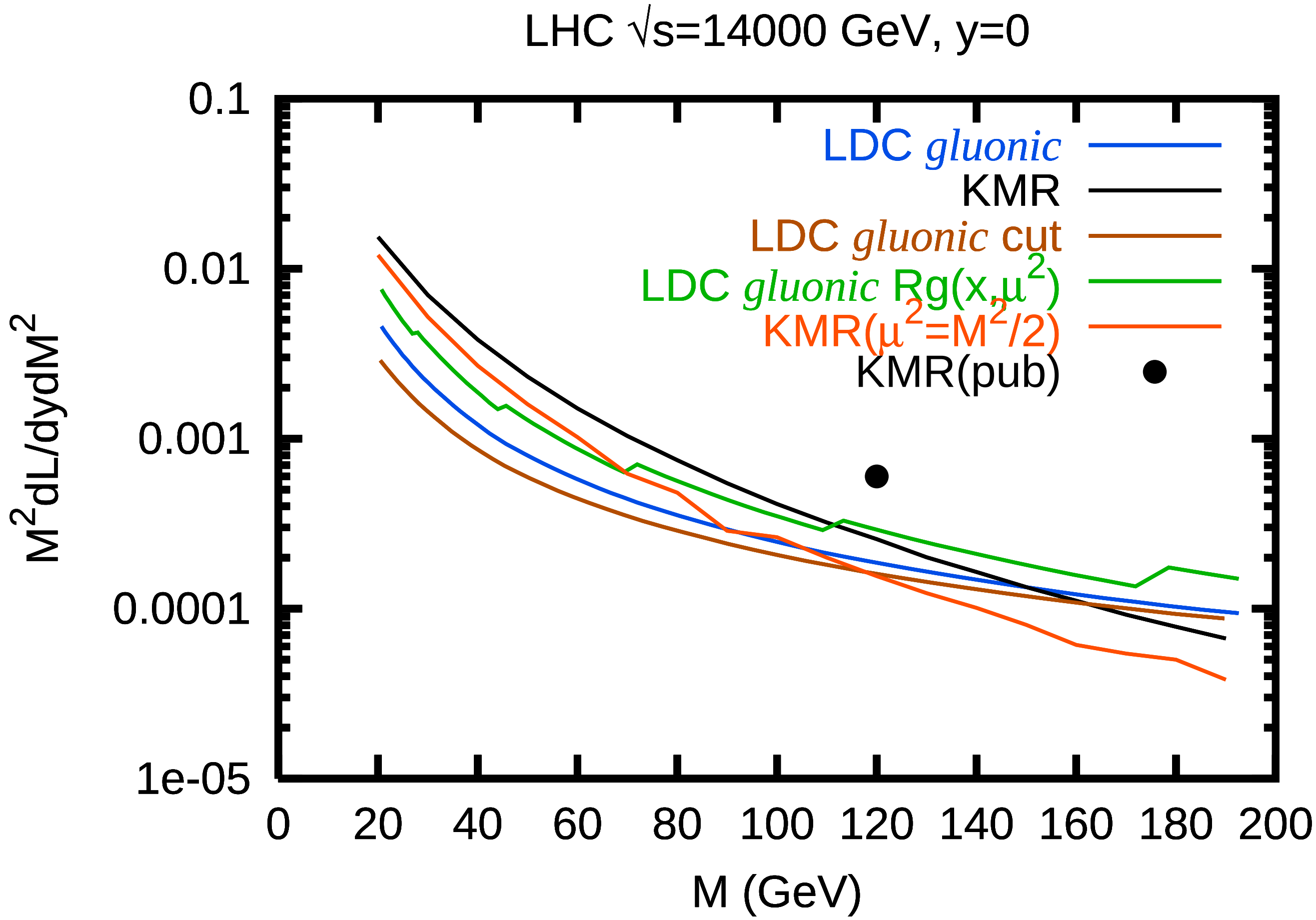
M (GeV)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KMR(μ2=M2/2)
KMR(pub)

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