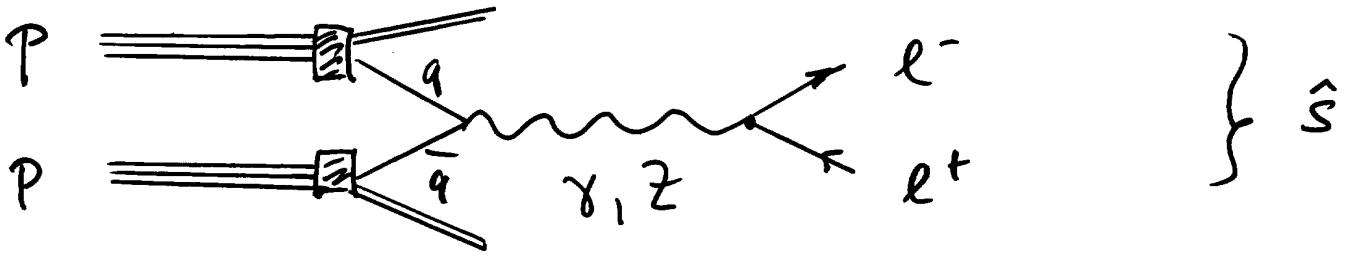
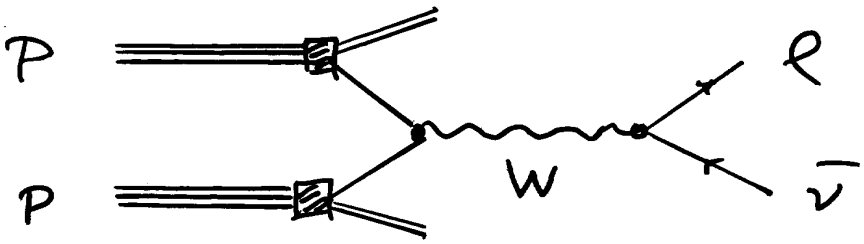
EW radiative corrections to $q\bar{q} \to \ell^+\ell^-$ (status)

W. Hollik





EW higher order contributions to be studied

precise measurements of M_W, $\sin^2\theta_{W,l}$.

$A_{FB}(s')$, ... $\longrightarrow$ parton distribution, possible new physic.

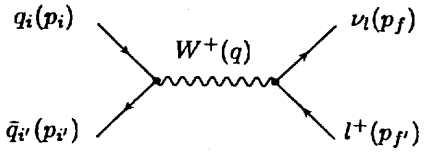
see M. Dittmar, D. Burilkov } meeting 22/1/99

$q\bar{q}' \to W \to l\nu$ around resonance

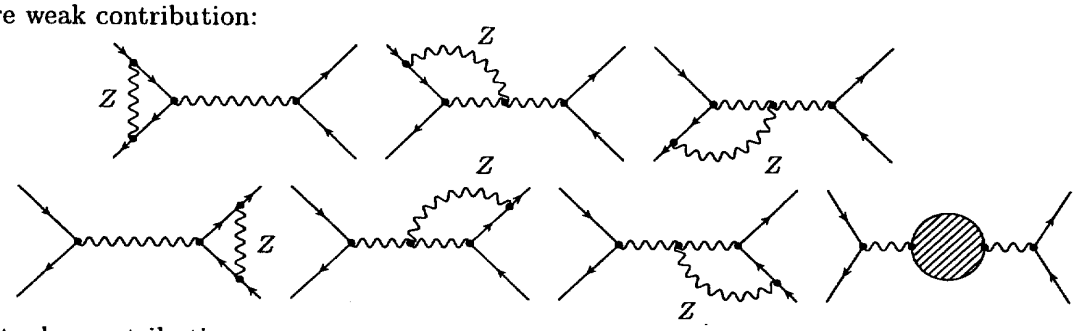
Baur, Keller, Wackeroth

[D. Wackeroth, 22/1/99]

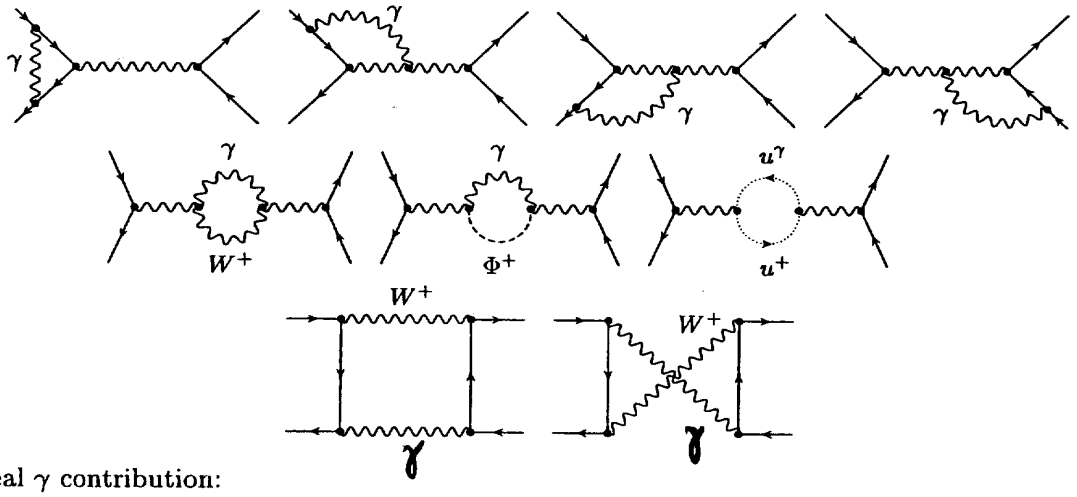
Born-diagram:



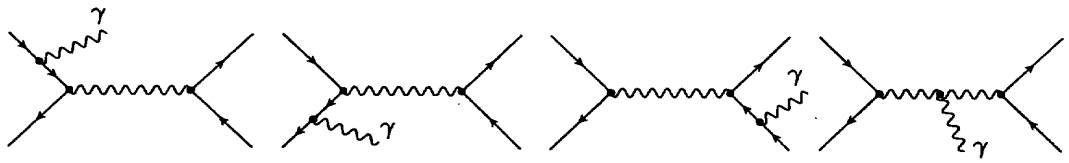
pure weak contribution:



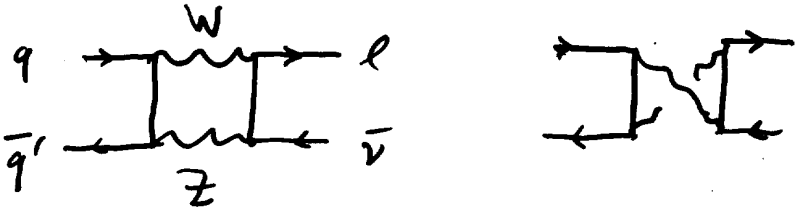
virtual γ contribution:



real γ contribution:



Continuum > M_W

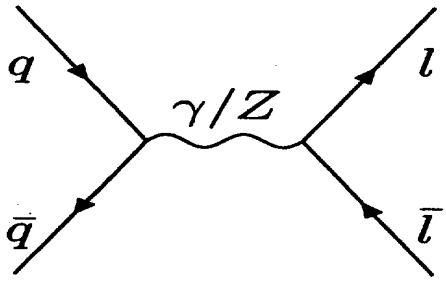


} at work

Fermion-pair Production

D. Bourilkov

TEVATRON, LHC...



LEP, SLC...

$$\frac{d\sigma}{d\Omega} \propto A_0(1+\cos^2\theta) + A_1 \cos\theta$$

$$A_0 = Q_q^2 Q_l^2 + 2Q_q Q_l v_q v_l \Re\chi(s) + (v_q^2 + a_q^2)(v_l^2 + a_l^2)|\chi(s)|^2$$

$$A_1 = 4Q_q Q_l a_q a_l \Re\chi(s) + 8 v_q a_q v_l a_l |\chi(s)|^2$$

$$\chi(s) = \frac{s}{(s - M_Z^2) + is\frac{\Gamma_Z}{M_Z}}$$

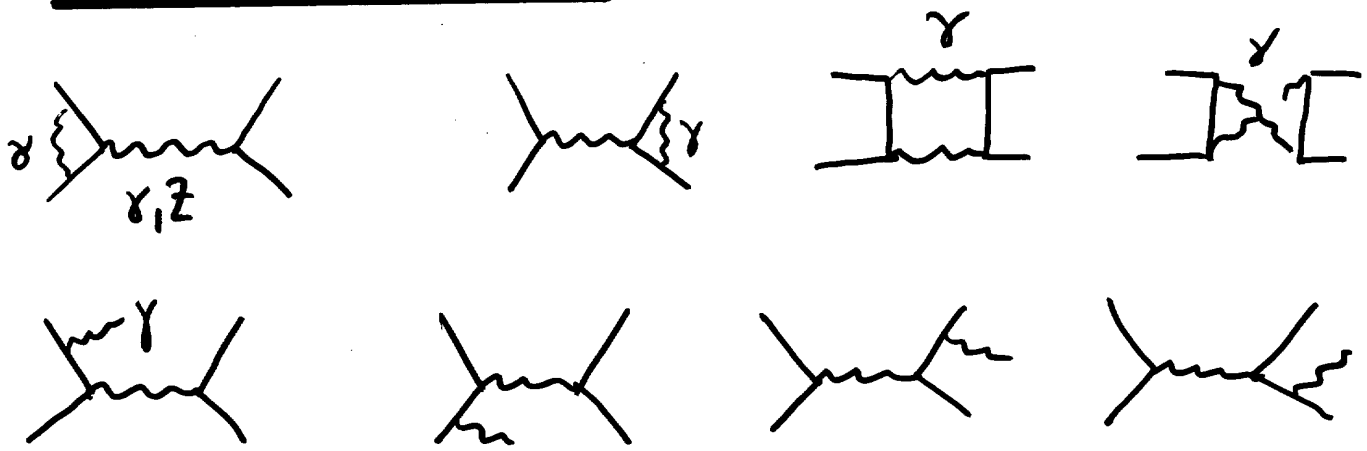
$v_f = \frac{1}{2s_W c_W}(T_f^3 - 2s_W^2 Q_f)$
$a_f = \frac{1}{2s_W c_W} T_f^3$

G_μ - Born: use Fermi constant for Z
running e.m. charge for γ

$Q_q Q_e \rightarrow \frac{Q_q Q_e}{1-\Delta\alpha(s)}$ $\Delta\alpha$ from light f

$\frac{1}{2 s_W c_W} \rightarrow (G_\mu M_Z^2 \sqrt{2})^{1/2}$, $s_W^2 = \sin^2\theta_{eff}(M_Z)$

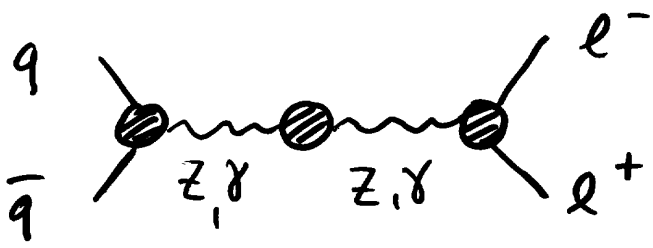
Z, γ exchange



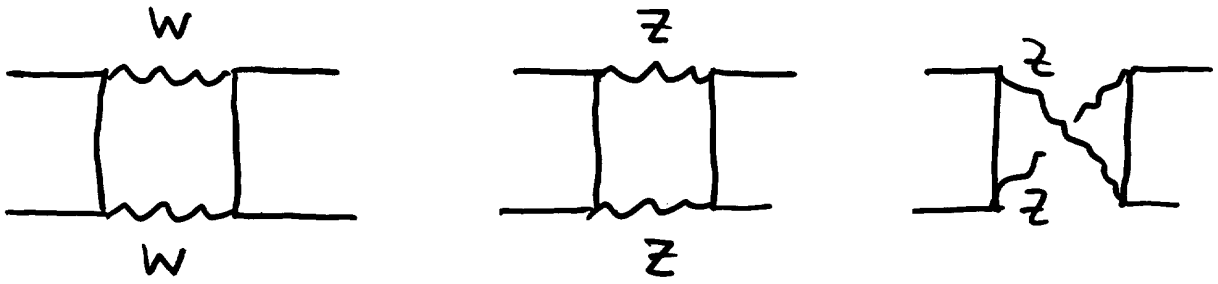
QED corrections

Baur, Keller, Sakumoto

non-QED corrections:

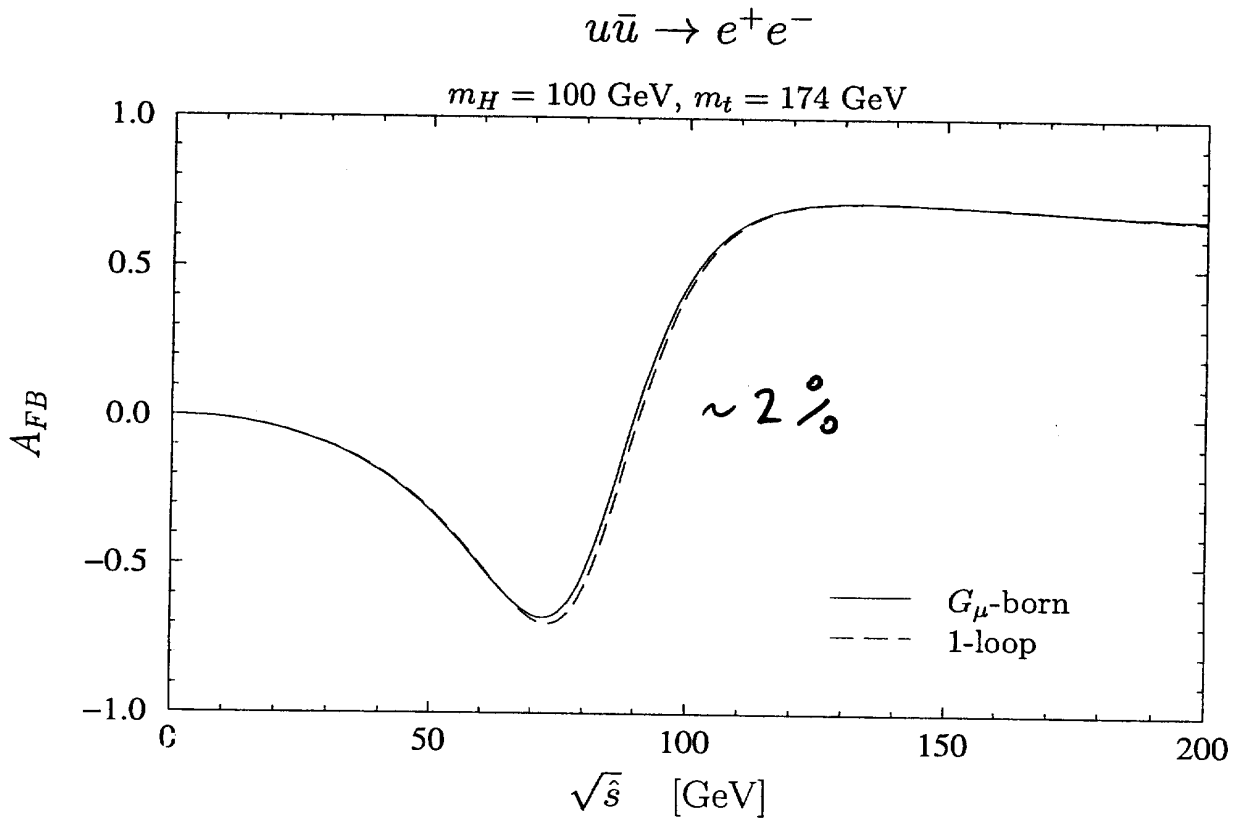


vertex
propagator
} corr.



box diagrams

C. Schappacher, WH

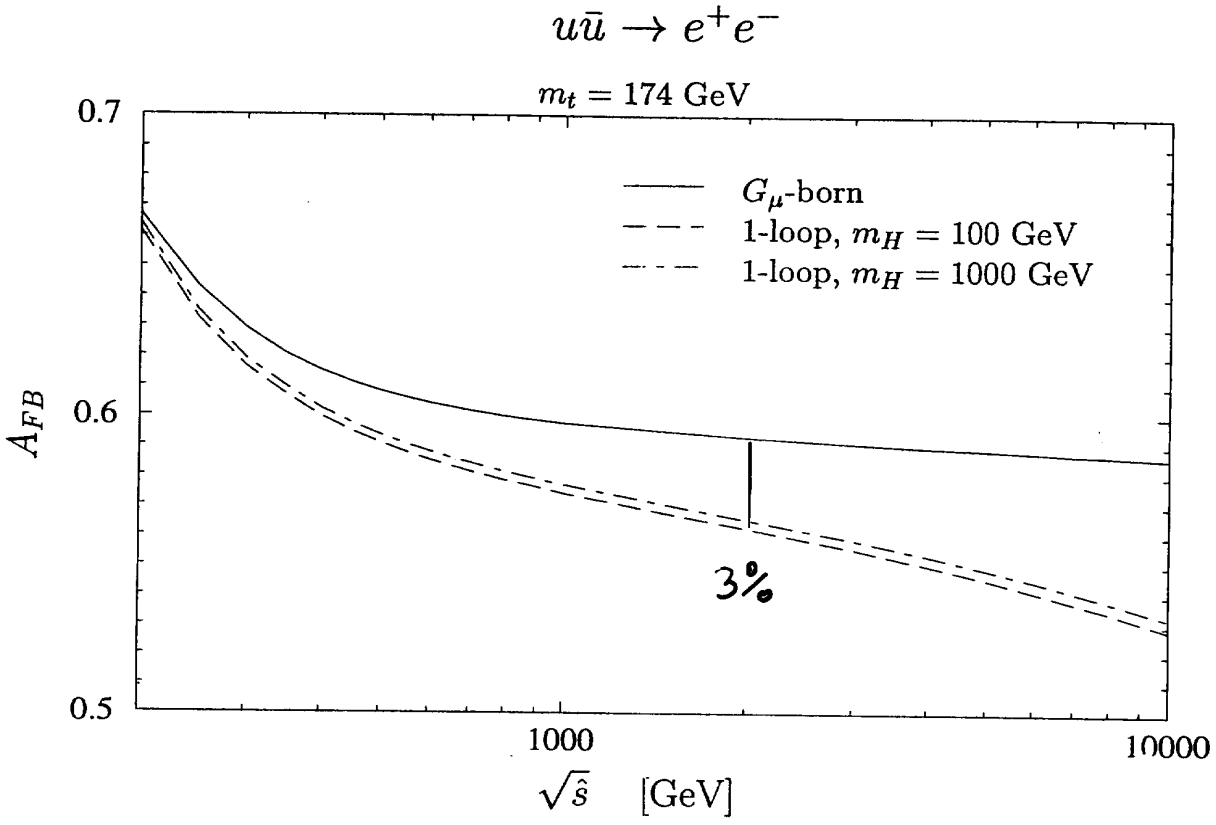


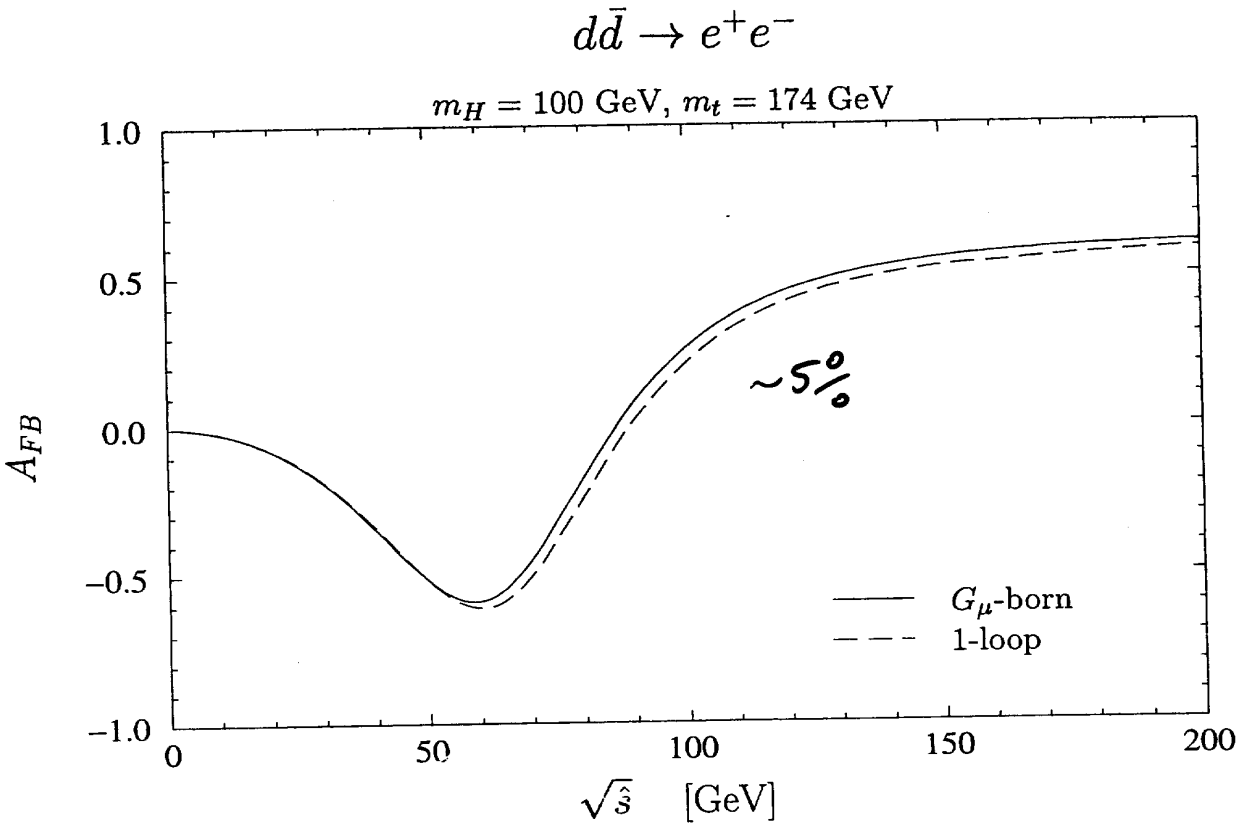
$q\bar{q} \to e^+e^-$, $q = u, d$

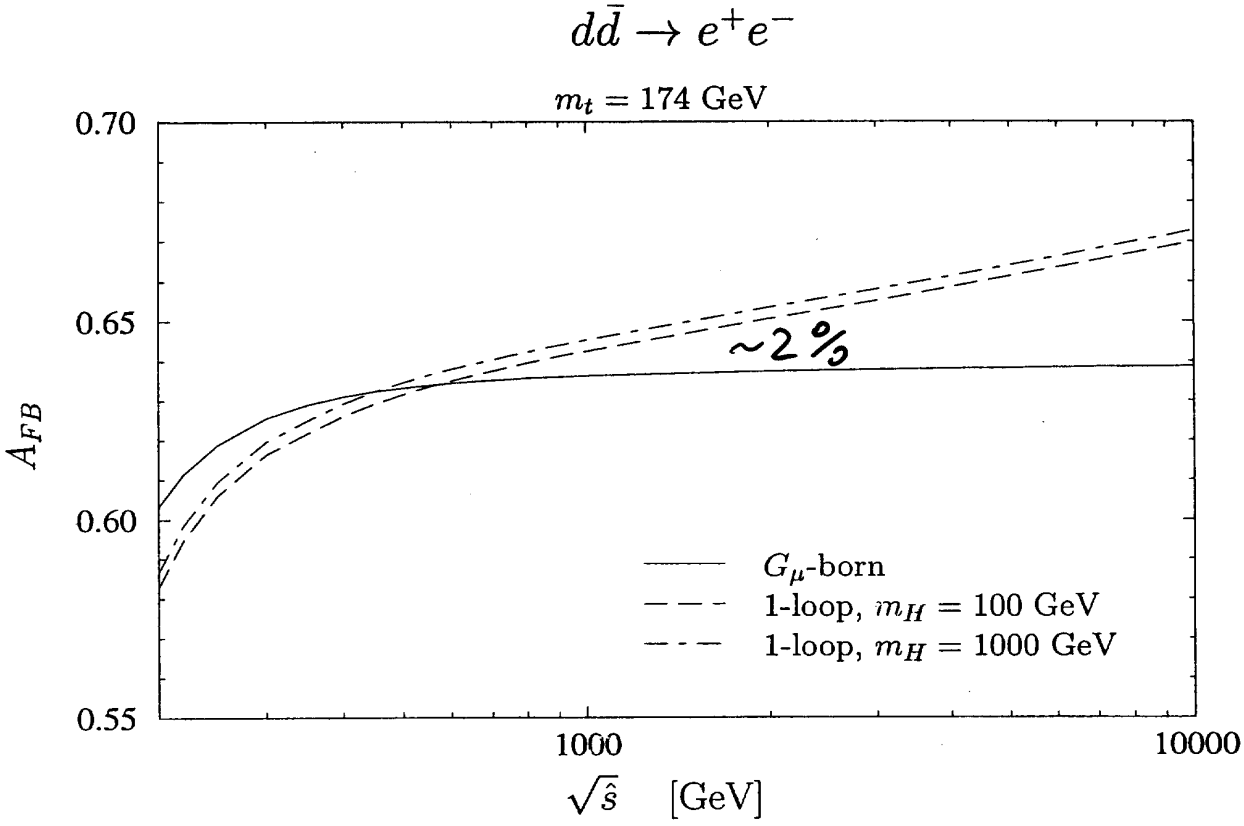
complete 1-loop parton cross sections

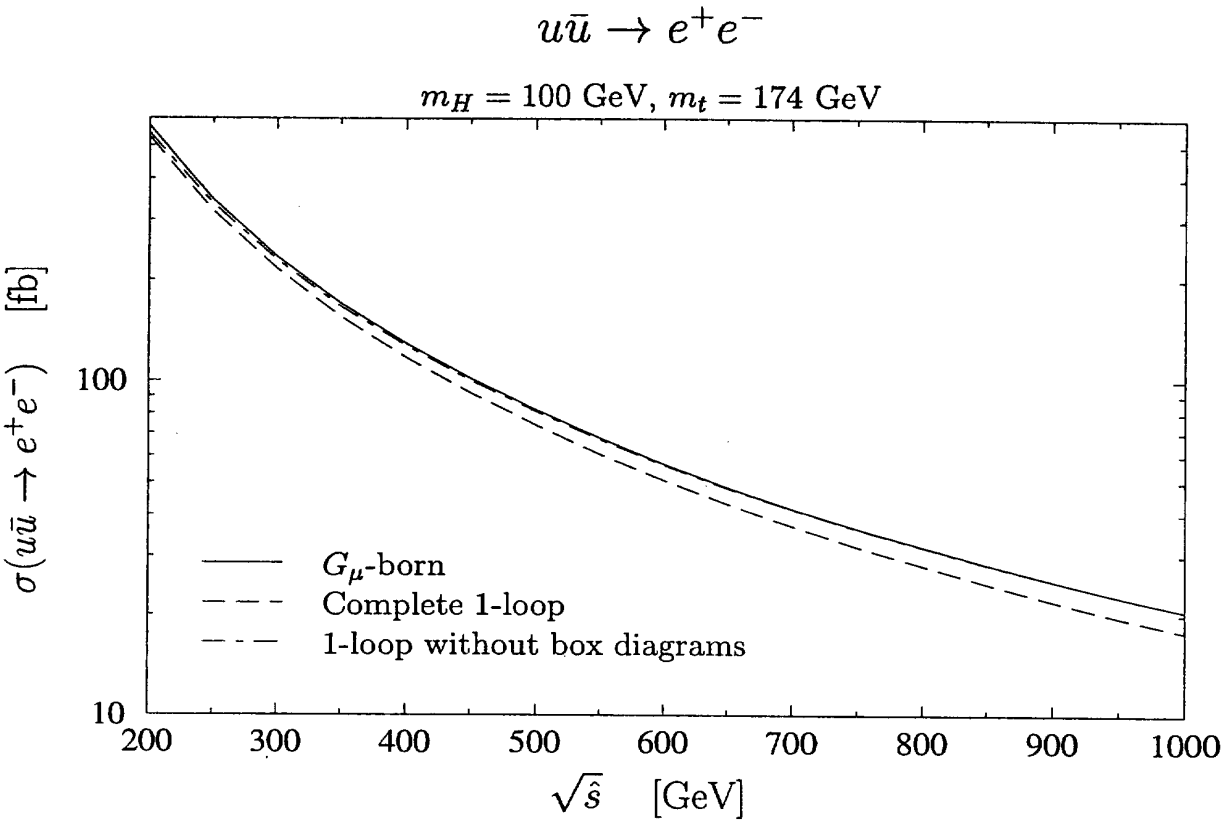
$\frac{d\sigma}{d\Omega}^q (\hat{s}, \theta, M_Z, m_t, M_H \ldots)$

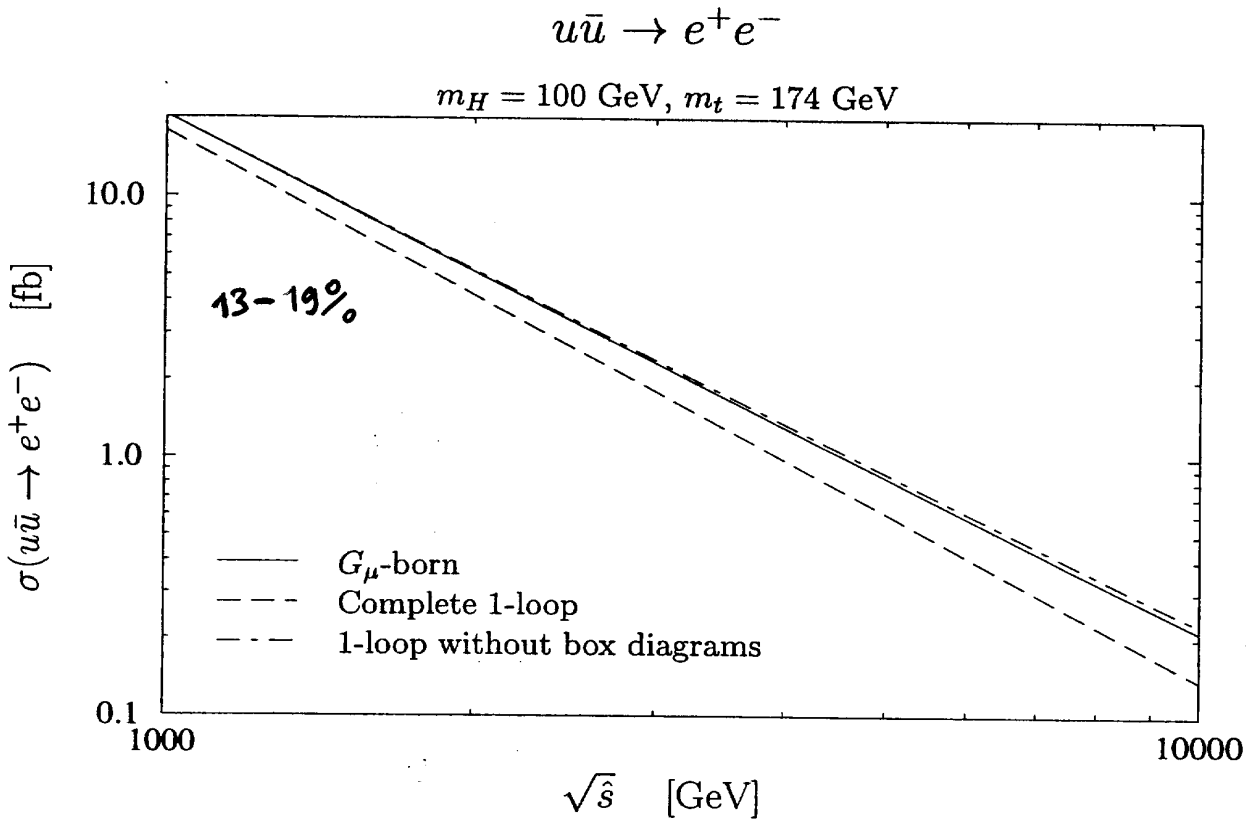
ready to be convoluted with PDF

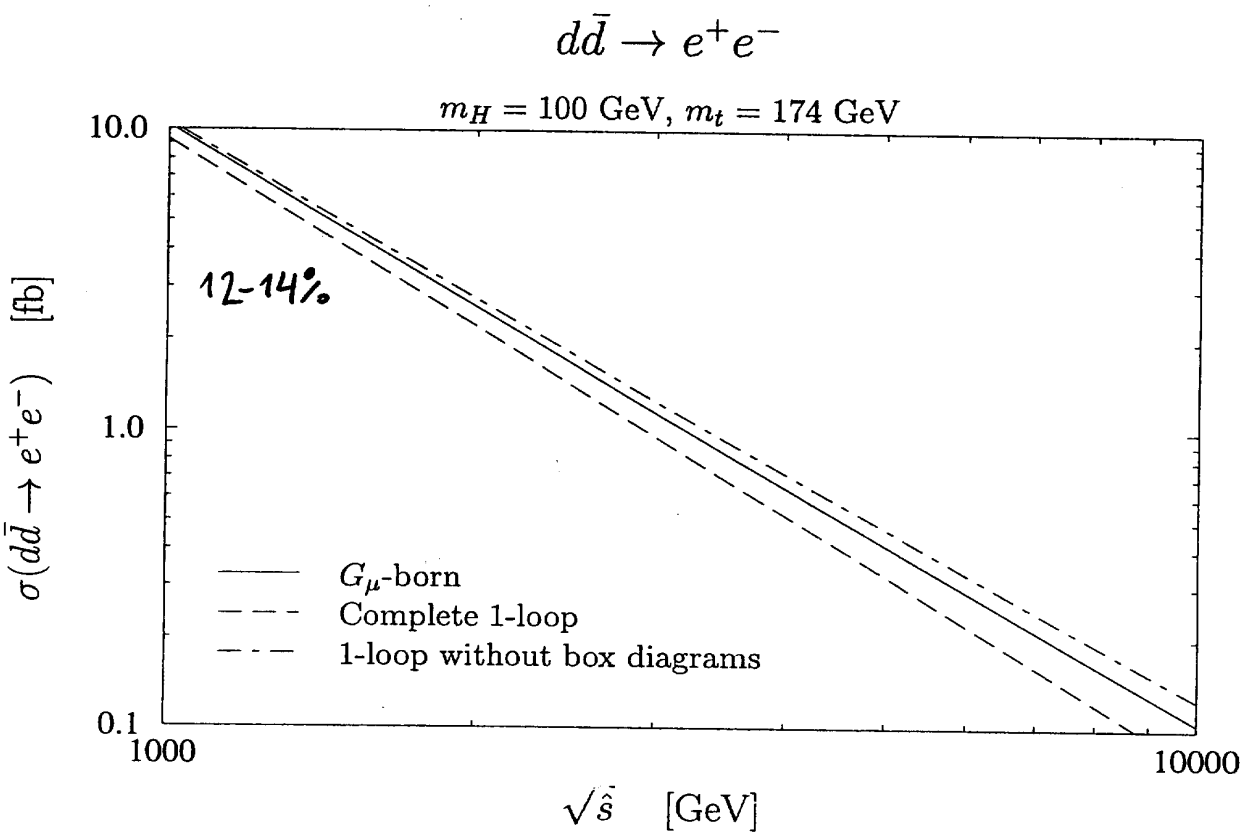

$u\bar{u} \to e^+e^-$
$m_t = 174$ GeV
G_μ-born
1-loop, $m_H = 100$ GeV
1-loop, $m_H = 1000$ GeV
3%
0.7
0.6
0.5
A_{FB}
1000
10000
$\sqrt{\hat{s}}$ [GeV]

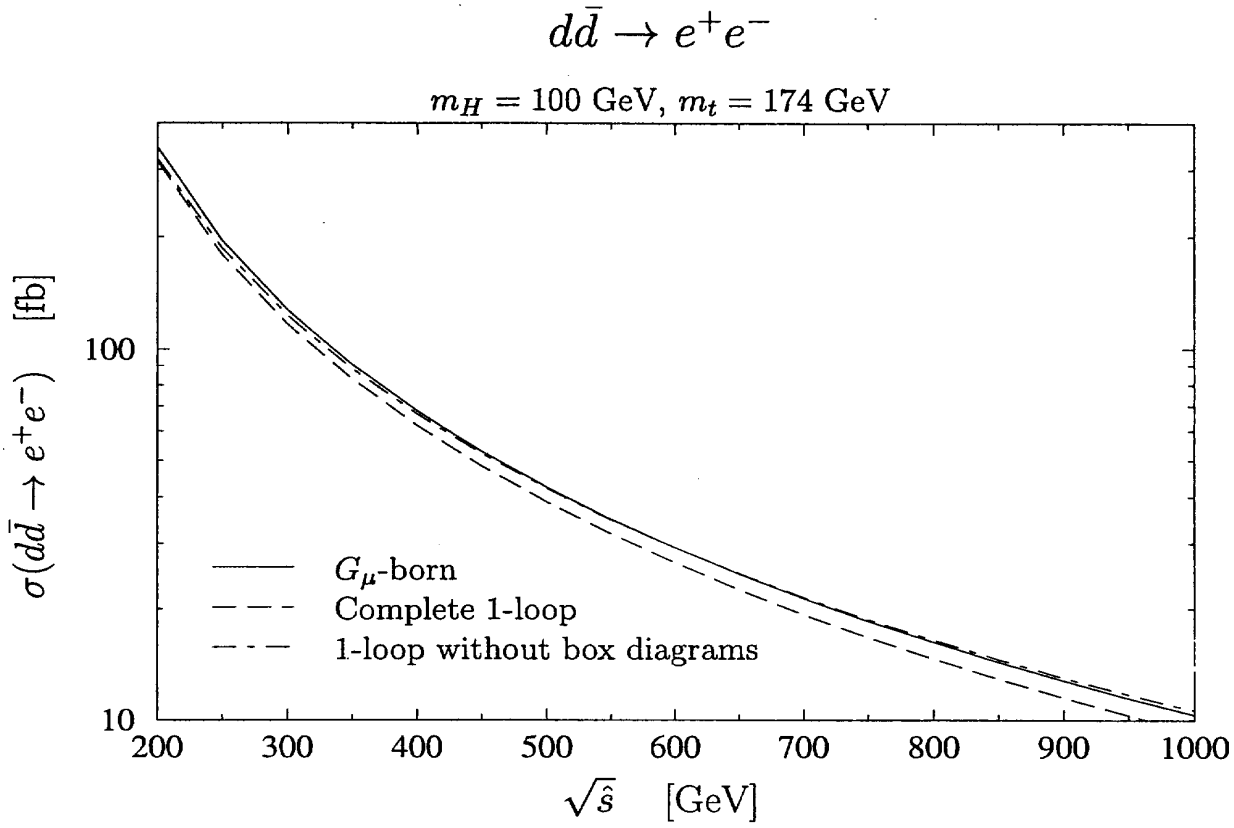

$d\bar{d} \to e^+e^-$
$m_H = 100$ GeV, $m_t = 174$ GeV
1.0
0.5
0.0
−0.5
−1.0
A_{FB}
0
50
100
150
200
$\sqrt{\hat{s}}$ [GeV]
G_μ-born
1-loop
~5%

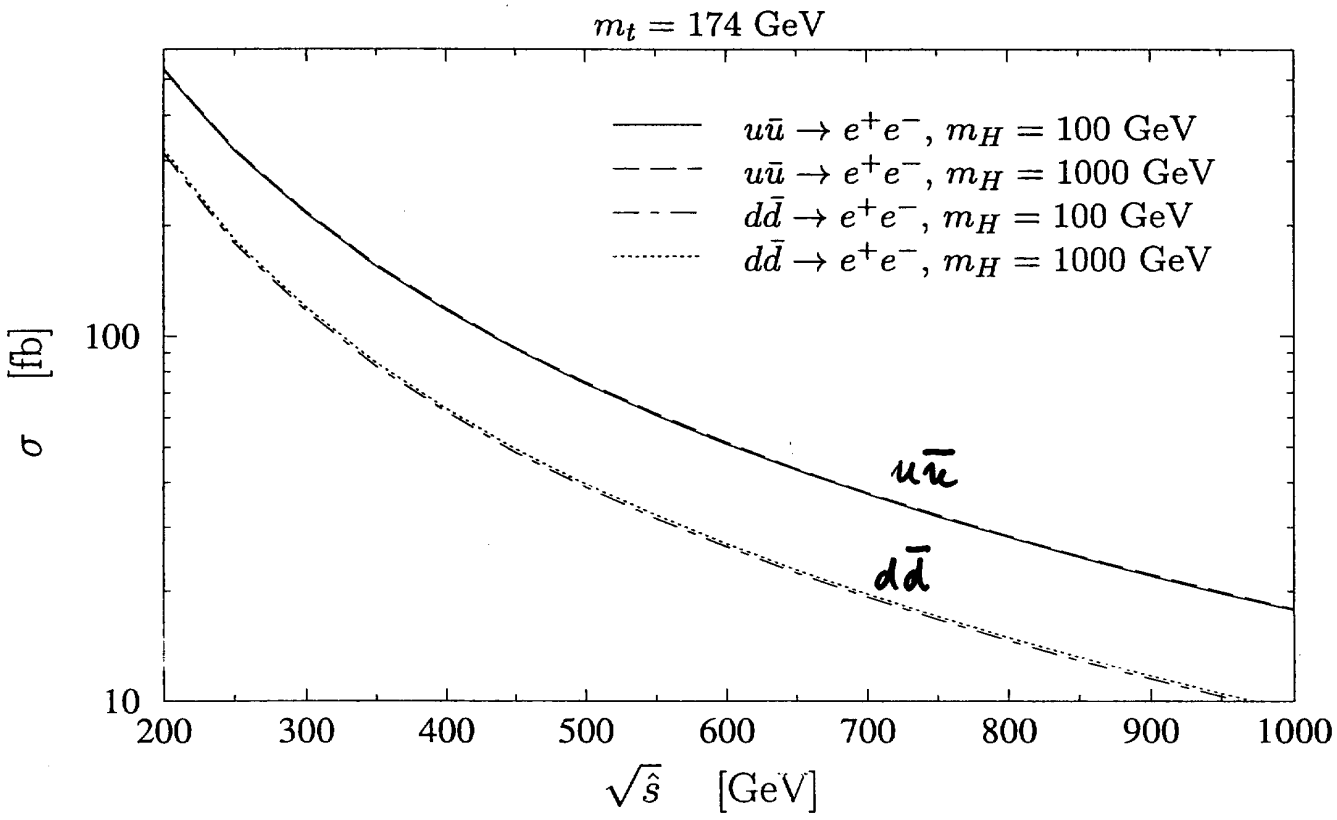

$d\bar{d} \to e^+e^-$
$m_t = 174$ GeV
0.70
0.65
0.60
0.55
A_{FB}
~2%
G_μ-born
1-loop, $m_H = 100$ GeV
1-loop, $m_H = 1000$ GeV
1000
10000
$\sqrt{\hat{s}}$ [GeV]


$u\bar{u} \to e^+e^-$
$m_H = 100$ GeV, $m_t = 174$ GeV
$\sigma(u\bar{u} \to e^+e^-)$ [fb]
100
10
200
300
400
500
600
700
800
900
1000
$\sqrt{\hat{s}}$ [GeV]
G_μ-born
Complete 1-loop
1-loop without box diagrams


$u\bar{u} \to e^+e^-$
$m_H = 100$ GeV, $m_t = 174$ GeV
10.0
1.0
0.1
1000
10000
$\sigma(u\bar{u} \to e^+e^-)$ [fb]
$\sqrt{\hat{s}}$ [GeV]
13-19%
G_μ-born
Complete 1-loop
1-loop without box diagrams


$d\bar{d} \to e^+e^-$
$m_H = 100$ GeV, $m_t = 174$ GeV
10.0
1.0
0.1
1000
10000
12-14%
$\sigma(d\bar{d} \to e^+e^-)$ [fb]
$\sqrt{\hat{s}}$ [GeV]
G_μ-born
Complete 1-loop
1-loop without box diagrams


$d\bar{d} \to e^+e^-$
$m_H = 100$ GeV, $m_t = 174$ GeV
$\sigma(d\bar{d} \to e^+e^-)$ [fb]
100
10
200
300
400
500
600
700
800
900
1000
$\sqrt{\hat{s}}$ [GeV]
G_μ-born
Complete 1-loop
1-loop without box diagrams


$m_t = 174$ GeV
$u\bar{u} \to e^+e^-$, $m_H = 100$ GeV
$u\bar{u} \to e^+e^-$, $m_H = 1000$ GeV
$d\bar{d} \to e^+e^-$, $m_H = 100$ GeV
$d\bar{d} \to e^+e^-$, $m_H = 1000$ GeV
$u\bar{u}$
$d\bar{d}$
σ [fb]
100
10
200
300
400
500
600
700
800
900
1000
$\sqrt{\hat{s}}$ [GeV]

work do be done:

- parton level → $PP \to \ell^+\ell^- X$, ..
- cross checks [Dittmaier, Wackeroth]
- link to QED Monte Carlo [Baur et a
- completion of $q\bar{q}' \to W \to \ell\bar{\nu}$ [Dittmaier, Wackeroth]