Radiative effects in Drell-Yan process

Y. Dydyshka

The National Scientific and Educational Centre of Particle and High Energy Physics of the Belarusian State University (NC PHEP BSU).

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Outline

Motivation

The importance of The Drell-Yan process for doing physics at LHC is evident. At NC PHEP we carried out a dedicated calculation of first order EW RC effects to DY process. The aim of this report is to present results of calculations in three kinematical regions on M:

- Z_0-pole region (for calibration task),
- intermediate region from 250-1000 GeV (for luminosity measurement),
- high invariant mass region from 1-5 TeV (for looking for interesting physics).

The theoretical precision for the DY description has to be better than 1%. It is a challenge!

Cross check procedure of theoretical calculations:

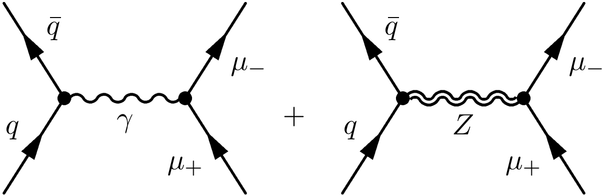
1. SANC group (arXiv:0711.0625v1 [hep-ph]),
2. Baur et al. (Phys. Rev. D65 (2002) 033007),
3. Carloni Calame et al.(JHEP 05 (2005) 019, hep-ph/0502218),
4. Dittmaer (Phys. Rev. D65 (2002) 073007, hep-ph/0109062),
5. Zykunov (Phys. Rev. D75 (2007) 073019, hep-ph/0509315).

Born level diagrams

At the leading order partonic cross section of subprocess

$$q(p_1) + \bar{q}(p_2) \xrightarrow{\gamma,Z} \mu(p_3) + \bar{\mu}(p_4) \quad (1)$$

represented by following two diagrams:



(2)

Born cross section

$$\frac{d\hat{\sigma}^{\mathsf{B}}}{dy} = \frac{\pi\alpha^2}{3s}\frac{\Lambda_1^{\mathsf{B}}t^2 + \Lambda_2^{\mathsf{B}}u^2}{s^2}, \quad y = -t/s \tag{3}$$

$$\hat{\sigma}^{\mathsf{B}} = \frac{\pi\alpha^2}{9s}(\Lambda_1^{\mathsf{B}} + \Lambda_2^{\mathsf{B}}), \tag{4}$$

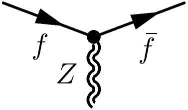
we introduse the following notations systematically:

$$\Lambda_1^{\mathsf{B}} = \left|D_{+-}^{\mathsf{B}}\right|^2 + \left|D_{-+}^{\mathsf{B}}\right|^2, \tag{5}$$

$$\Lambda_2^{\mathsf{B}} = \left|D_{++}^{\mathsf{B}}\right|^2 + \left|D_{--}^{\mathsf{B}}\right|^2, \tag{6}$$

$$D_{ij}^{\mathsf{B}} = Q(q)Q(\mu) + g_i(q)g_j(\mu)\frac{s}{s - M_Z^2 + iM_Z\Gamma_Z}, \tag{7}$$

Neutral current constants



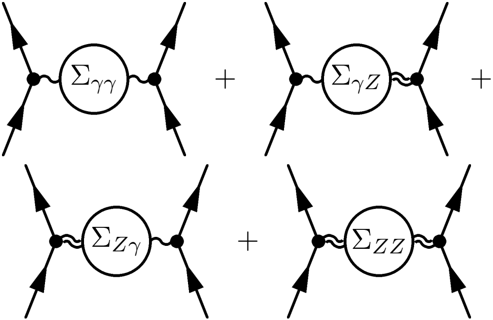
$$= ie\gamma^{\mu}\left(g_{-}(f)\omega_{-} + g_{+}(f)\omega_{+}\right) \quad (8)$$

$$g_{+}(f) = g_{R}(f) = -\frac{s_w}{c_w}Q(f), \quad (9)$$

$$g_{-}(f) = g_{L}(f) = g_{+}(f) + \frac{T_w(f)}{s_w c_w} \quad (10)$$

Where $Q(f)$ and $T_w(f)$ are charge and weak isospin of the fermion f.

Boson self energies



$$\hat{\sigma}^{\text{SE}}(y) = \frac{\pi\alpha^2}{3s}\frac{\Lambda_1^{\text{SE}}t^2 + \Lambda_2^{\text{SE}}u^2}{s^2}, \tag{11}$$

$$\Lambda_1^{\text{SE}} = 2\text{Re}\left[D_{+-}^{*\text{B}}D_{+-}^{\text{SE}} + D_{-+}^{*\text{B}}D_{-+}^{\text{SE}}\right], \tag{12}$$

$$\Lambda_2^{\text{SE}} = 2\text{Re}\left[D_{++}^{*\text{B}}D_{++}^{\text{SE}} + D_{--}^{*\text{B}}D_{--}^{\text{SE}}\right], \tag{13}$$

$$D_{ij}^{\text{SE}}(s) = Q(q)F_j^{\text{SE}}(\mu) + g_i(q)G_j^{\text{SE}}(\mu)\frac{s}{s - M_Z^2 + iM_Z\Gamma_Z}, \tag{14}$$

$$F_{\pm}^{SE}(\mu) = -Q(\mu)\Pi_{\gamma\gamma}(s) + g_{\pm}(\mu)\Pi_{Z\gamma}(s), \quad (15)$$

$$G_{\pm}^{SE}(\mu) = +Q(\mu)\Pi_{\gamma Z}(s) - g_{\pm}(\mu)\Pi_{ZZ}(s). \quad (16)$$

$$\Pi_{\gamma\gamma}(s) = \frac{\Sigma_{\gamma\gamma}(s)}{s}, \qquad \Pi_{Z\gamma}(s) = \frac{\Sigma_{\gamma Z}(s)}{s - M_Z^2 + iM_Z\Gamma_Z} \quad (17)$$

$$\Pi_{\gamma Z}(s) = \frac{\Sigma_{\gamma Z}(s)}{s}, \qquad \Pi_{ZZ}(s) = \frac{\Sigma_{ZZ}(s)}{s - M_Z^2 + iM_Z\Gamma_Z} \quad (18)$$

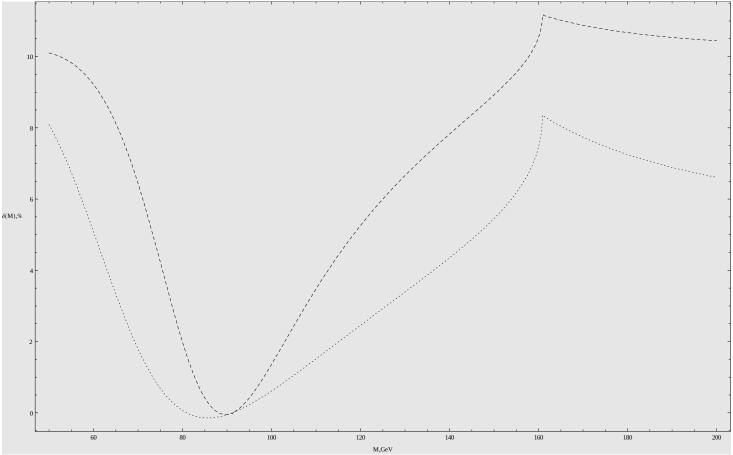
Dyson resummation

$$F^{SE}_{\pm}(\mu) = Q(\mu)\frac{1+\Pi_{ZZ}(s)}{\Omega(s)} + g_{\pm}(\mu)\frac{\Pi_{Z\gamma}(s)}{\Omega(s)}, \tag{19}$$

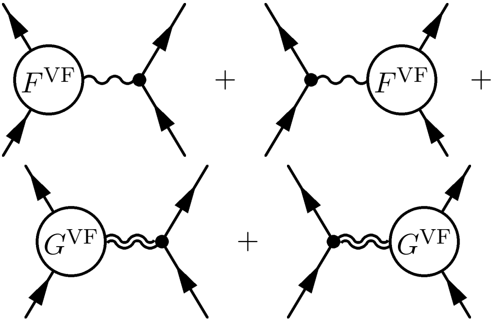
$$G^{SE}_{\pm}(\mu) = Q(\mu)\frac{\Pi_{\gamma Z}(s)}{\Omega(s)} + g_{\pm}(\mu)\frac{1+\Pi_{\gamma\gamma}(s)}{\Omega(s)}, \tag{20}$$

$$\Omega(s) = [1+\Pi_{\gamma\gamma}(s)][1+\Pi_{ZZ}(s)] - \Pi_{\gamma Z}(s)\Pi_{Z\gamma}(s). \tag{21}$$

Self-energy contribution at partonic level



relative corrections to up-type quarks (dashed), down-type quarks (dotted line) partonic xsection


$F^{\rm VF}$
+
$F^{\rm VF}$
+
$G^{\rm VF}$
+
$G^{\rm VF}$

Vertex contribution

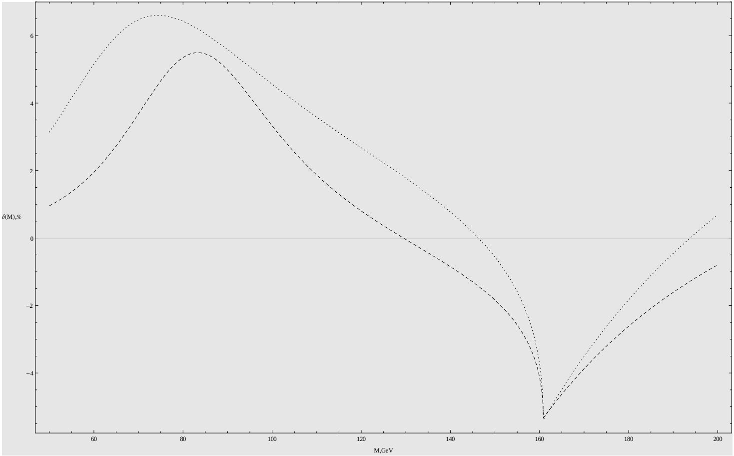
$$\hat{\sigma}^{\text{VF}}(y) = \frac{\pi\alpha^2}{3s}\frac{\Lambda_1^{\text{VF}}t^2 + \Lambda_2^{\text{VF}}u^2}{s^2}, \tag{22}$$

$$\Lambda_1^{\text{VF}} = 2\text{Re}[D^{*\text{B}}_{+-}D^{\text{VF}}_{+-} + D^{*\text{B}}_{-+}D^{\text{VF}}_{-+}], \tag{23}$$

$$\Lambda_2^{\text{VF}} = 2\text{Re}[D^{*\text{B}}_{++}D^{\text{VF}}_{++} + D^{*\text{B}}_{--}D^{\text{VF}}_{--}], \tag{24}$$

$$D^{\text{VF}}_{ij}(s) = F_i^{\text{VF}}(q)Q(\mu) + G_i^{\text{VF}}(q)g_j(\mu)\frac{s}{s - M_Z^2 + iM_Z\Gamma_Z},$$
$$+ Q(q)F_j^{\text{VF}}(\mu) + g_i(q)G_j^{\text{VF}}(\mu)\frac{s}{s - M_Z^2 + iM_Z\Gamma_Z}. \tag{25}$$

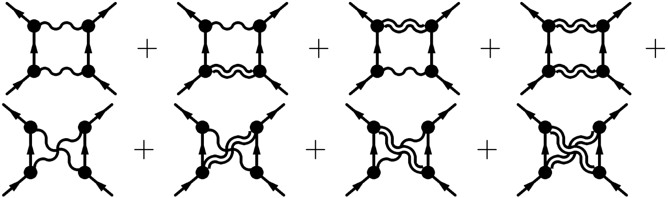
Finite vertex contribution at partonic level



relative corrections to up-type quarks (dashed), down-type quarks (dotted line) partonic xsection

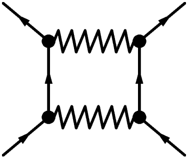
Box diagrams

$D^{\mathrm{BX}} \sim$

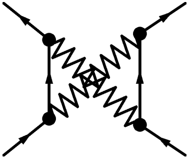


(26)

$D^{\mathrm{WW}} \sim$



or



$\sim \log^2 \frac{s}{M_W^2}$ (27)

Box cross section

$$\hat{\sigma}^{\mathrm{BX}}(y) = \frac{\pi\alpha^2}{3s}\frac{\Lambda_1^{\mathrm{BX}} t^2 + \Lambda_2^{\mathrm{BX}} u^2}{s^2}, \tag{28}$$

$$\Lambda_1^{\mathrm{BX}} = 2\mathrm{Re}\left[D_{+-}^{*\mathrm{B}} D_{+-}^{\mathrm{BX}} + D_{-+}^{*\mathrm{B}} D_{-+}^{\mathrm{BX}}\right], \tag{29}$$

$$\Lambda_2^{\mathrm{BX}} = 2\mathrm{Re}\left[D_{++}^{*\mathrm{B}} D_{++}^{\mathrm{BX}} + D_{--}^{*\mathrm{B}} \left(D_{--}^{\mathrm{BX}} + D^{\mathrm{WW}}\right)\right], \tag{30}$$

$$D_{ij}^{BX}(s,t,u) = Q(q)Q(\mu)F_{ij}^{BX} + g_i(q)g_j(\mu)G_{ij}^{BX}, \tag{31}$$

$$D^{WW}(s,t,u) = \frac{\alpha}{4\pi} g_w^4 s H_q(s,t,u,M_W,M_W) \tag{32}$$

Box form-factors:

$$F_{\pm\mp}^{BX} = -\frac{\alpha}{4\pi} s \left[Q(q)Q(\mu)H(s,t,u,\lambda,\lambda) + g_{\pm}(q)g_{\mp}(\mu)H(s,t,u,M_Z,\lambda)\right], \tag{33}$$

$$G_{\pm\mp}^{BX} = -\frac{\alpha}{4\pi} s \left[Q(q)Q(\mu)H(s,t,u,\lambda,M_Z) + g_{\pm}(q)g_{\mp}(\mu)H(s,t,u,M_Z,M_Z)\right]$$

After tensor reduction:

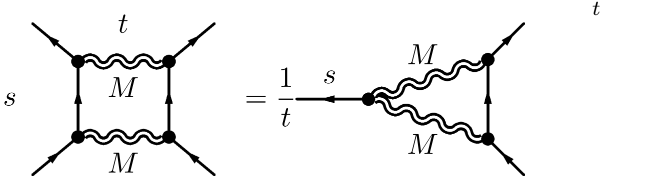
$$H(s,t,u,M_1,M_2) = H_u(s,t,u,M_1,M_2) + H_d(s,t,u,M_1,M_2) \tag{34}$$

$$H_u(s,t,u,M_1,M_2) = -4C_0(s,M_1,M_2) + 2uD_0(s,u,M_1,M_2), \tag{35}$$

$$\begin{aligned} H_d(s,t,u,M_1,M_2) &= 2\frac{B_0(t) - B_0(s,M_1,M_2)}{u} \\ &+ 2\frac{t^2+u^2-s(M_1^2+M_2^2)}{u^2}C_0(s,M_1,M_2) \\ &- t\frac{t-u+M_1^2+M_2^2}{u^2}(C_0(t,M_1)+C_0(t,M_2)) \\ &- \frac{t((t+M_1^2+M_2^2)^2+u^2)+2M_1^2M_2^2u}{u^2}D_0(s,t,M_1,M_2). \end{aligned} \tag{36}$$

Functional identity

G. 't Hooft, M. Veltman, Nuclear Physics B 153, 365 (1979).



(37)

There is also more general case:

$$D_0(s,t,M_1,M_2) = \frac{M_2^2}{tM_1^2} C_0\left(M_2^4\left(\frac{1}{t}+\frac{1}{M_1^2}\right), s\frac{M_2^2}{M_1^2}, M_2^4\left(\frac{1}{t}+\frac{1}{M_2^2}\right), 0, \frac{M_2^4}{M_1^2}, M_2^2\right), \quad (38)$$

Shifted dimension identity

O. V. Tarasov, Physical Review D 54, 6479 (1996).

$$D_0(s,t,M_1^2,M_2^2) = \frac{G_3}{2\Delta_4} D_0^{(6)}(s,t,M_1^2,M_2^2) - \sum_{k=1}^{4} \frac{\partial_k \Delta_4}{2\Delta_4} C_{0,k} \qquad (39)$$

$$\Delta_4 = t\left(t\lambda(s,M_1^2,M_2^2) - 4sM_1^2M_2^2\right), \qquad G_3 = -2stu \qquad (40)$$

$$\partial_1\Delta_4 = -2t(2M_2^2 s + (-M_1^2 + M_2^2 + s)t), \quad \partial_2\Delta_4 = 2st(M_1^2 + M_2^2 - s),$$
$$\partial_3\Delta_4 = -2t(2M_1^2 s + (M_1^2 - M_2^2 + s)t), \quad \partial_4\Delta_4 = 2st(M_1^2 + M_2^2 - s).$$

IR singularities in $\gamma\gamma$-box

$$D_0(s,t,\lambda^2,\lambda^2) = -2\frac{u}{st}D_0^{(6)}(s,t,\lambda^2,\lambda^2) + 2\frac{sC_0(s,\lambda^2)+tC_0(t,\lambda^2)}{st} \quad (41)$$

$$D_0^{(6)}(s,t,\lambda^2,\lambda^2) = D_0^{(6)}(s,t,0,0) = \frac{1}{2u}\left(\log^2\frac{t+i\epsilon}{s+i\epsilon}+\pi^2\right) \quad (42)$$

$$H(s,t,u,\lambda^2,\lambda^2) = 2\frac{B_0(t) - B_0(s)}{u} + 4\frac{uC_0(u,\lambda^2) - tC_0(t,\lambda^2)}{s} + 2uD_0^{(6)}(s,u,0,0) - \frac{t^2+u^2}{u^2} tD_0^{(6)}(s,t,0,0) \quad (43)$$

$$H(s,t,u,\lambda^2,\lambda^2) = \frac{2}{u}\log\frac{s}{-t} - \frac{2}{s}\log\frac{t}{u}\log\frac{tu}{\lambda^4} - \frac{2}{s}\log^2\frac{-u}{s} + \frac{t^2+u^2}{u^2}\frac{1}{s}\log^2\frac{-t}{s} \quad (44)$$

IR singularities in γZ-box

$$D_0(s,t,\lambda^2,M_Z^2) = \frac{2M_Z^2 s + t(s+M_Z^2)}{t(s-M_Z^2)^2} C_0(t,M_Z^2) - \frac{1}{s-M_Z^2} C_0(t,\lambda^2) + \frac{2s}{t(s-M_Z^2)} C_0(s,M_Z^2,\lambda^2) - \frac{2su}{t(s-M_Z^2)^2} D_0^{(6)}(s,t,\lambda^2,M_Z^2) \tag{45}$$

$$D_0^{(6)}(s,t,\lambda^2,M_Z^2) = \frac{M_Z^2 - s}{su} \log\left(1-\frac{s}{M_Z^2}\right) \log\frac{-t}{M_Z^2} + \frac{M_Z^2+t}{tu} \log\left(1+\frac{t}{M_Z^2}\right) \log\frac{-t}{M_Z^2} + \frac{M_Z^2-s}{su} \mathrm{Li}_2\frac{s}{M_Z^2} + \frac{M_Z^2+t}{tu} \mathrm{Li}_2\frac{-t}{M_Z^2} \tag{46}$$

$$
\begin{aligned}
H(s,t,u,M_Z^2,\lambda^2) = & \frac{2}{u}[B_0(s,0,M_Z^2) - B_0(t,0,0)] \\
& + \frac{2}{s-M_Z^2}[uC_0(u,\lambda^2) - tC_0(t,\lambda^2)] \\
& + \frac{2(t+M_Z^2)(M_Z^4+tM_Z^2-su)}{u(s-M_Z^2)^2}C_0(t,M_Z^2) \\
& + \frac{2u(s+M_Z^2)+4sM_Z^2}{(s-M_Z^2)^2}C_0(u,M_Z^2) \\
& + \frac{2s[u^2+(t+M_Z^2)^2]}{u(s-M_Z^2)^2}D_0^{(6)}(s,t,M_Z^2,0) \\
& - \frac{4st}{(s-M_Z^2)^2}D_0^{(6)}(s,u,M_Z^2,0) \qquad (47)
\end{aligned}
$$

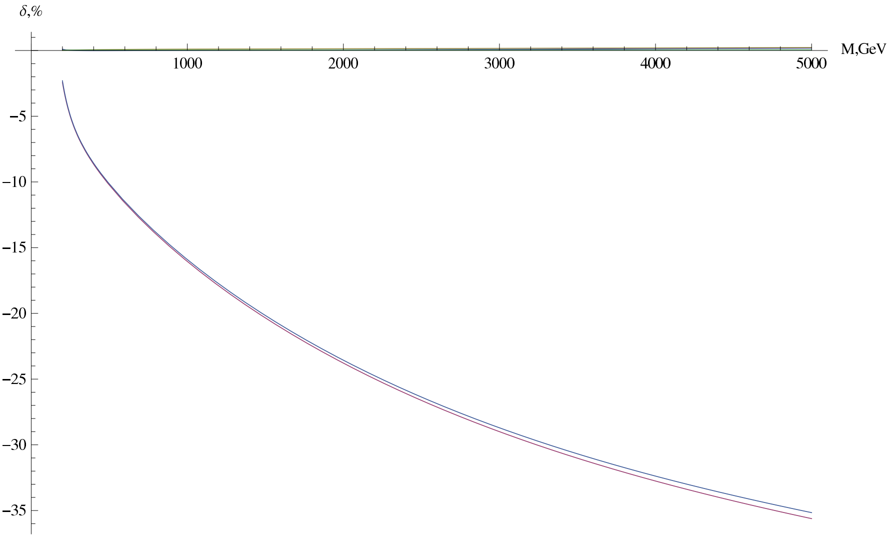


Figure: Relative correction from boxes

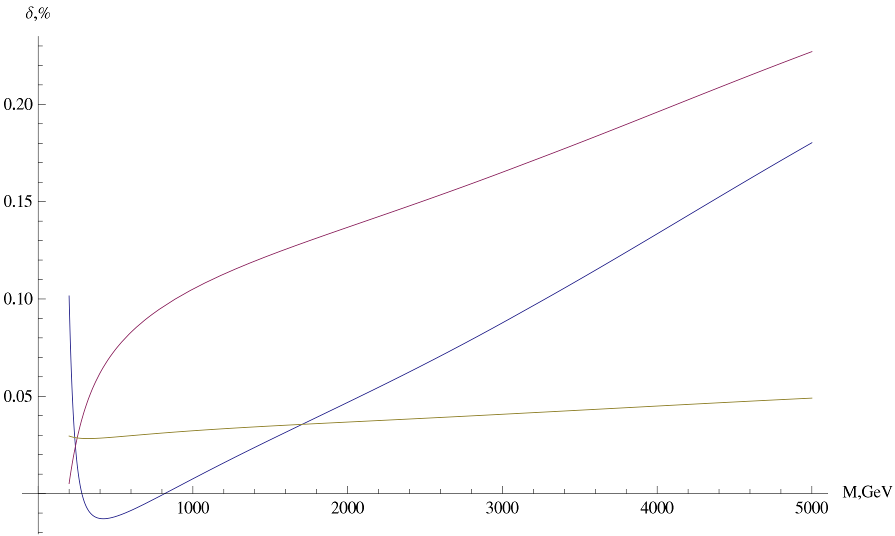
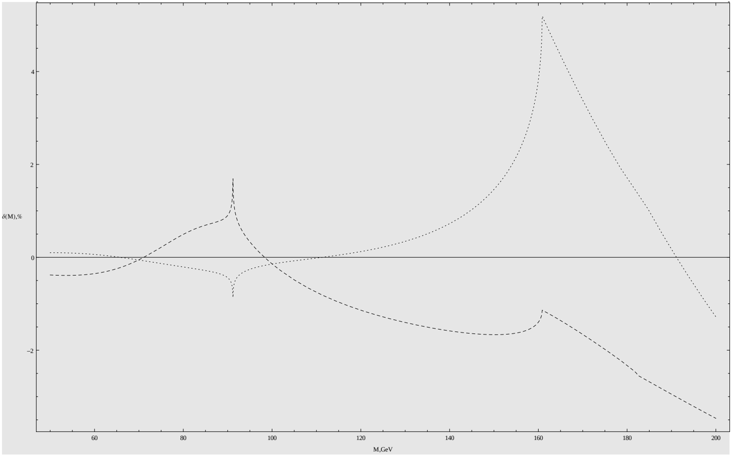


Figure: Relative correction from finite light boxes

Finite box contribution at partonic level



relative corrections to up-type quarks (dashed), down-type quarks (dotted line)

partonic xsection

Bremsstrahlung

$$q(p_1) + \bar{q}(p_2) \xrightarrow{\gamma,Z} \mu(p_3) + \bar{\mu}(p_4) + \gamma(k).$$

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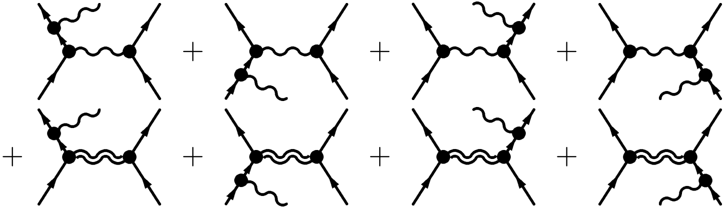


(48)

$$d\hat{\sigma}^{\mathsf{H}} = \frac{\pi\alpha^2}{3s}\frac{\alpha}{4\pi}|\bar{M}|^2 dR_3 \tag{49}$$

$$R_3 = \frac{\pi}{16s}\int\frac{ds_1 dt dz dz_1}{\sqrt{-\Delta_4}} \tag{50}$$

$$\Delta_4(p_1,p_2,k_1,k_2) = \frac{1}{16}\lambda(ss_1,tt_1,uu_1) \tag{51}$$

$$z_1 = 2p_1\cdot k_3, \qquad v_1 = 2p_2\cdot k_3 \tag{52}$$

$$z = 2k_1\cdot k_3, \qquad v = 2k_2\cdot k_3 \tag{53}$$

$$t = -2p_1\cdot k_1, \qquad u = -2p_1\cdot k_2 \tag{54}$$

$$t_1 = -2p_2\cdot k_2, \qquad u_1 = -2p_2\cdot k_1 \tag{55}$$

$$s = 2p_1\cdot p_2, \qquad s_1 = 2k_1\cdot k_2 \tag{56}$$

One of the amplitudes

$$M_{+-;+} = 2\,\bar{t}^2 \left[D_{+-}(s_1) \frac{\sqrt{2}Q(q)}{\bar{s}_1 \bar{z}_1 \bar{v}_1} - D_{+-}(s) \frac{\sqrt{2}Q(\mu)}{\bar{s}\bar{z}\bar{v}} \right] \quad (57)$$

$$|M_{+-;+}|^2 = -2\frac{t^2}{ss_1}[D_{+-}(s_1)V(q) - D_{+-}(s)(\mu)V(\mu)]^2 \quad (58)$$

$$V(q) = 2Q(q)\left(\frac{p_1}{z_1} - \frac{p_2}{v_1}\right) \quad (59)$$

$$V(\mu) = 2Q(\mu)\left(\frac{k_1}{z} - \frac{k_2}{v}\right) \quad (60)$$

$$|M^{pole}_{+-;+}|^2 = -2\frac{tt_1}{ss_1}\left[|2Q(q)D_{+-}(s_1)|^2 \left(\frac{m_q^2}{v_1^2} + \frac{m_q^2}{z_1^2}\right)\right. \quad (61)$$

$$\left. + |2Q(\mu)D_{+-}(s)|^2 \left(\frac{m^2}{v^2} + \frac{m^2}{z^2}\right)\right] \quad (62)$$

Parametrization by azimutal angle

$$\bar{t} = \frac{\sqrt{szv_1} + e^{i\phi_t}\sqrt{s_1 v z_1}}{s - s_1}, \qquad t = -\bar{t} \cdot \bar{t}^*, \tag{63}$$

$$\bar{t}_1 = \frac{\sqrt{sz_1 v} + e^{i\phi_t}\sqrt{s_1 v_1 z}}{s - s_1}, \qquad t_1 = -\bar{t}_1 \cdot \bar{t}_1^*, \tag{64}$$

$$\bar{u}_1 = \frac{\sqrt{szz_1} - e^{i\phi_t}\sqrt{s_1 v v_1}}{s - s_1}, \qquad u_1 = -\bar{u}_1 \cdot \bar{u}_1^*, \tag{65}$$

$$\bar{u} = \frac{\sqrt{svv_1} - e^{i\phi_t}\sqrt{s_1 z z_1}}{s - s_1}, \qquad u = -\bar{u} \cdot \bar{u}^*, \tag{66}$$

$$R_3 = \frac{\pi}{8s} \int \frac{dz dz_1 ds_1}{s - s_1} \int_0^{2\pi} d\phi_t \tag{67}$$

Azimutal integrals

$$\int_0^{2\pi} d\phi_t \left(t^2\right) = 2\pi \frac{s^2 v_1^2 z^2 + s_1^2 v^2 z_1^2 + 4 s s_1 v v_1 z z_1}{(s - s_1)^2} \tag{68}$$

$$\int_0^{2\pi} d\phi_t \left(t t_1\right) = 2\pi \frac{(s^2 + s_1^2) v v_1 z z_1 + s s_1 (v_1 z + v z_1)}{(s - s_1)^4} \tag{69}$$

$$\int_0^{2\pi} d\phi_t \frac{t_1^2}{s s_1} \left(\frac{t}{z z_1} + \frac{t_1}{v v_1} - \frac{u}{z_1 v} - \frac{u_1}{z v_1} \right) = -8\pi \frac{s_1 v_1 z + s v z_1}{(s - s_1)^4} \tag{70}$$

Invariant mass distribution

$$\frac{d\hat{\sigma}}{ds_1}^{\text{ISR}} = \frac{\pi\alpha^2}{9s^2}\frac{\alpha}{4\pi}\frac{1}{s_1}\frac{s^2+s_1^2}{s-s_1}Q(q)^2\left[\Lambda_1^{\text{B}}(s_1)+\Lambda_2^{\text{B}}(s_1)\right]\left(\log\frac{s}{m_q^2}-1\right), \quad (71)$$

$$\frac{d\hat{\sigma}}{ds_1}^{\text{FSR}} = \frac{\pi\alpha^2}{9s^2}\frac{\alpha}{4\pi}\frac{1}{s}\frac{s^2+s_1^2}{s-s_1}Q(\mu)^2\left[\Lambda_1^{\text{B}}(s)+\Lambda_2^{\text{B}}(s)\right]\left(\log\frac{s_1}{m^2}-1\right), \quad (72)$$

$$\frac{d\hat{\sigma}}{ds_1}^{\text{INT}} = \frac{\pi\alpha^2}{9s^2}\frac{\alpha}{4\pi}\frac{s+s_1}{s-s_1}Q(\mu)Q(q)\left[\Lambda_1^{\text{B}}(s,s_1)-\Lambda_2^{\text{B}}(s,s_1)\right]. \quad (73)$$

Substraction of quark mass singularities

conterterm from Arbuzov, A., et al, Jan. 2006. One-loop corrections to the Drell-Yan process in SANC (i). the charged current case. The EPJ C 46 (2), 407-412.

$$\delta\left(\frac{d\hat{\sigma}}{ds_1}^{\text{ISR}}\right) = \frac{\alpha}{\pi}Q(q)^2\frac{s^2+s_1^2}{(s-s_1)^2}\left(\log\frac{\mu^2}{m_q^2}-1-2\log\frac{s-s1}{s}\right)\hat{\sigma}^B(s_1). \tag{74}$$

after substraction:

$$\frac{d\hat{\sigma}}{ds_1}^{\text{ISR}} = \frac{\pi\alpha^2}{9s_1}\frac{\alpha}{4\pi}\frac{s-s_1}{s}\frac{s^2+s_1^2}{(s-s_1)^2}Q(q)^2\left[\Lambda_1^{\text{B}}(s_1)+\Lambda_2^{\text{B}}(s_1)\right]\log\frac{(s-s_1)^2}{s\mu^2}. \tag{75}$$

Soft and Virtual photons

$$d\hat{\sigma}^{S,ISR} = \frac{\alpha}{\pi} Q(q)^2 \left[\log \frac{w_{sep}^2}{s\lambda^2} \left(\log \frac{s}{m_q^2} - 1 \right) - \frac{1}{2} \log^2 \frac{s}{m_q^2} + \log \frac{s}{m_q^2} - \frac{\pi^2}{3} \right] d\hat{\sigma}^B(s). \quad (76)$$

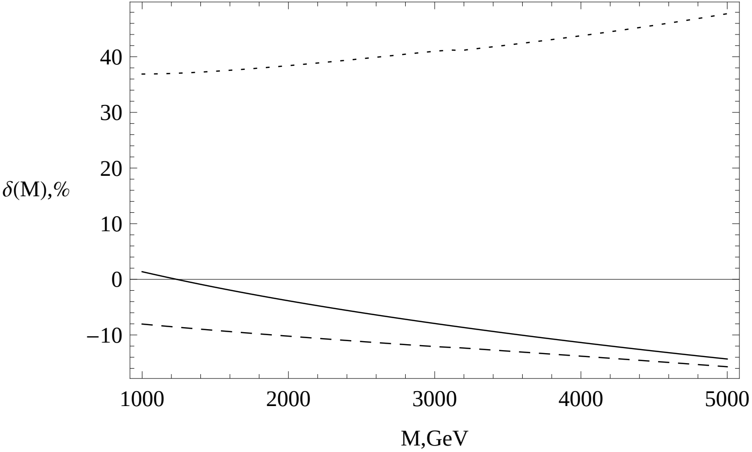
$$d\hat{\sigma}^{V,QED} = \frac{\alpha}{\pi} Q(q)^2 \left[\log \frac{\lambda^2}{m_q^2} \left(\log \frac{s}{m_q^2} - 1 \right) - \frac{1}{2} \log^2 \frac{s}{m_q^2} + \frac{3}{2} \log \frac{s}{m_q^2} + \frac{2\pi^2}{3} - 2 \right] d\hat{\sigma}^B(s). \quad (77)$$

$$\delta\left(\hat{\sigma}^{SV,ISR}\right) = \frac{\alpha}{\pi} Q(q)^2 \left[2\log\frac{w_{sep}}{s}\left(\log\frac{\mu^2}{m_q^2} - 1\right) - \frac{1}{2}\log^2\frac{w_{sep}^2}{s^2} + \frac{3}{2}\log\frac{\mu^2}{m_q^2} + 2 \right] \hat{\sigma}^B(s). \tag{78}$$

Resulting sum is free from IR and collinear singularities:

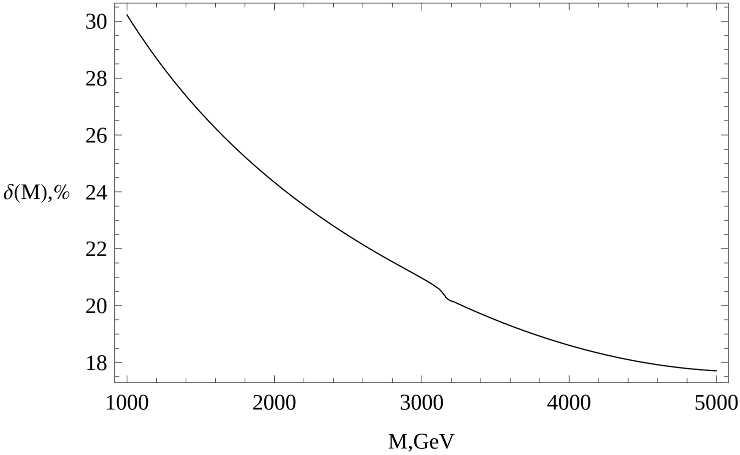
$$d\hat{\sigma}^{V,QED} + d\hat{\sigma}^{S,ISR} - \delta\left(\hat{\sigma}^{SV,ISR}\right) = \frac{\alpha}{\pi} Q(q)^2 \left[2\log^2\frac{w_{sep}}{s} + \frac{\pi^2}{3} - 4 \right] d\hat{\sigma}^B(s) \tag{79}$$

Three components of the whole RC for NC Drell-Yan



QED (dashed), weak (solid), and QCD(dotted line) radiative corrections to $\sigma(M)$

The whole one-loop RC



The whole one-loop correction to $\sigma(M)$

Conclusions

- A complete calculation of order O(α) EW RC to cross section for the DY process has been carried out.
- Monte Carlo event generator is in development;
- The procedure of validation of results is to be done;
- Corrections appear to be large for large invariant mass region;
- Problems to be solved
  - Higher order QED corrections are necessary
  - Higher order Weak corrections are necessary as well

Thank you for attention!