

Radiative Corrections in EpIC

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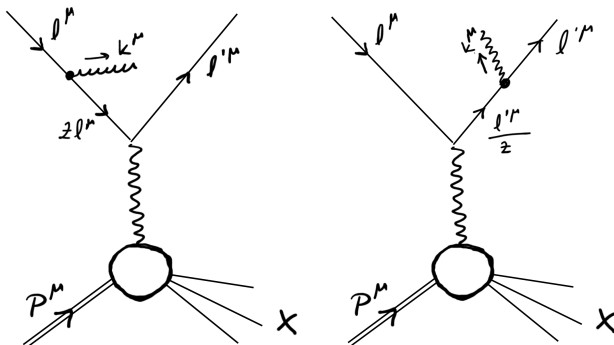
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Radiative Corrections in DIS

Collinear approximation: Neglect the transverse component of the 4-momenta of the emitted photon



Radiative Corrections in DIS

Initial and final state radiative corrections [Kripfganz, Möhring, Spiesberger, Z.Phys.C 49 (1991)]

$$\frac{d^2\sigma}{dx dy} = \int_0^1 \frac{dz_1}{z_1} D_{e/e}(z_1) \int_0^1 \frac{dz_3}{z_3^2} \bar{D}_{e/e}(z_3) \frac{y}{\hat{y}} \frac{d\hat{\sigma}_{\text{Born}}}{d\hat{x} d\hat{y}}$$

$$\frac{d^2\sigma}{dx dQ^2} = \int_0^1 dz_1 z_1 D_{e/e}(z_1) \int_0^1 \frac{dz_3}{z_3^2} \bar{D}_{e/e}(z_3) \frac{y}{\hat{y}} \frac{d\hat{\sigma}_{\text{Born}}}{d\hat{x} d\hat{Q}^2}$$

$$D_{e/e}(z) = \bar{D}_{e/e}(z) = \left[\delta(1-z) \left[1 + \frac{\alpha}{2\pi} L \left(2 \ln \epsilon + \frac{3}{2} \right) \right] + \theta(1-\epsilon-z) \frac{\alpha}{2\pi} L \frac{1+z^2}{1-z} \right]$$

where $L = \ln \frac{Q^2}{m_e^2}$

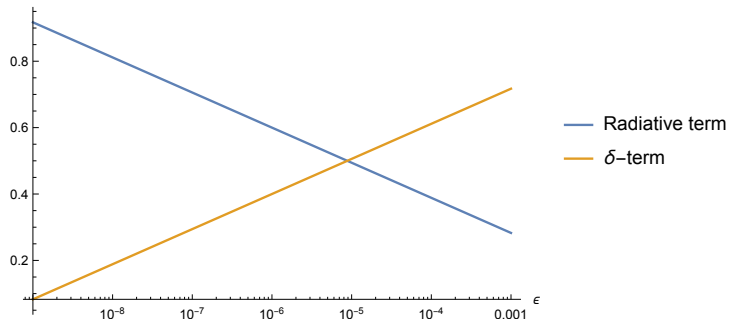
$$\hat{x} = \frac{z_1 xy}{z_1 z_3 + y - 1}, \quad \hat{y} = \frac{z_1 z_3 + y - 1}{z_1 z_3}, \quad \hat{Q}^2 = \frac{z_1}{z_3} Q^2$$

$$z_1^{\min} = \frac{1-y}{1-xy}, \quad z_3^{\min} = 1 - y(1-x)$$

Radiative Corrections in DIS

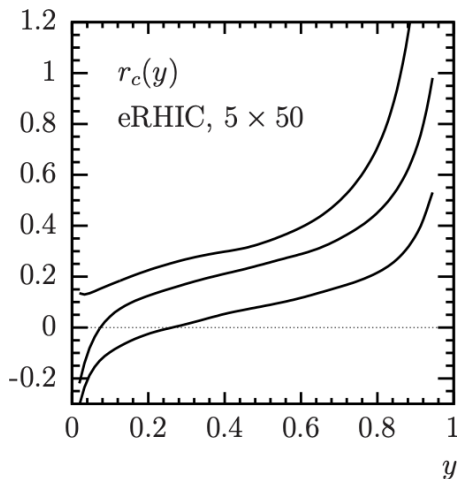
$$\int_0^1 dz \left[\delta(1-z) \left[1 + \frac{\alpha}{2\pi} L \left(2 \ln \epsilon + \frac{3}{2} \right) \right] + \theta(1-\epsilon-z) \frac{\alpha}{2\pi} L \frac{1+z^2}{1-z} \right]$$

$$Q^2 = 20 \text{ GeV}^2$$



Radiative Corrections in DIS

$$r_c(y) = \frac{d\sigma/dy|_{\alpha}}{d\sigma/dy|_{Born}} - 1 \quad [\text{The EIC Science case report, arXiv:1108.1713}]$$



Radiative Corrections in DVCS

Initial and final state radiative corrections [inferred from Hubert's talk – need to be confirmed]

$$\frac{d^5\sigma}{dx dQ^2 dt d\phi d\phi_S} = \int_0^1 dz_1 z_1 D_{e/e}(z_1) \int_0^1 \frac{dz_3}{z_3^2} \bar{D}_{e/e}(z_3) \frac{y}{\hat{y}} \frac{d^5\hat{\sigma}_{\text{Born}}}{d\hat{x} d\hat{Q}^2 dt d\phi d\phi_S}$$

Define new variables: $z_1 = 1 - 10^{z'_1}$, $z_3 = 1 - 10^{z'_3}$, $z'_1, z'_3 \in [-8, 0]$

$$\frac{d^5\sigma}{dx dQ^2 dt d\phi d\phi_S} = \int_{-8}^0 dz'_1 (1 - z_1) z_1 \ln(10) D_{e/e}(z_1) \int_{-8}^0 dz'_3 \frac{1 - z_3}{z_3^2} \ln(10) \bar{D}_{e/e}(z_3) \frac{y}{\hat{y}} \frac{d^5\hat{\sigma}_{\text{Born}}}{d\hat{x} d\hat{Q}^2 dt d\phi d\phi_S}$$

$$\hat{x} = \frac{z_1 xy}{z_1 z_3 + y - 1}, \quad \hat{y} = \frac{z_1 z_3 + y - 1}{z_1 z_3}, \quad \hat{Q}^2 = \frac{z_1}{z_3} Q^2$$

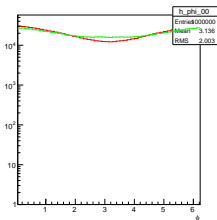
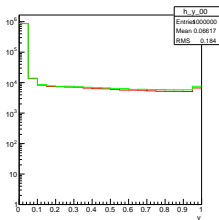
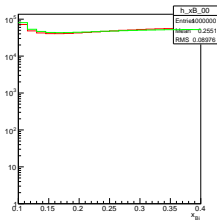
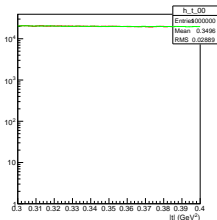
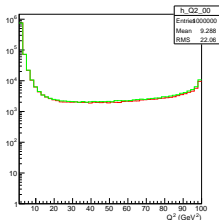
$$z_1^{\min} = \frac{1 - y}{1 - xy}, \quad z_3^{\min} = 1 - y(1 - x)$$

EplC – Output

```
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P 2 1 11 7.4438064962836825e-01 -8.9203700810106823e-01 -4.8715080338479311e+00 5.0081357170346941e+00 5.109115552153900e-04 1
P 3 1 22 -7.4438064962836825e-01 8.9203700810106823e-01 -1.2849194004468245e-01 -8.1357170387858606e-03 -1.1688783358963277e+00 3
P 4 0 2212 -0.000000000000000e+00 0.000000000000000e+00 4.9991195681135906e+01 5.000000000000000e+01 9.3827201299989860e-01 4
V -2 0 [3,4]
P 5 -2 22 -6.0989905039131687e-01 1.3968472453862832e+00 1.0072306633640153e+01 1.0186977962118174e+01 -1.2502775766493696e-06 1
P 6 -2 2212 -1.3448159923701342e-01 -5.0481023728535634e-01 3.9790397107463320e+01 3.9804886320855204e+01 9.3827201299989860e-01 1
E 2 3 8
U GEV MM
A 0 GenCrossSection 1.0000000e+00 0.0000000e+00 -1 -1
P 1 0 11 -0.000000000000000e+00 0.000000000000000e+00 -4.999999738880110e+00 5.000000000000000e+00 5.1099891404459905e-04 4
P 2 1 11 2.1557007737918865e-01 -1.4674521925430977e+00 -4.7935121438458737e+00 5.0177330867650003e+00 5.1103575047310907e-04 1
P 3 1 22 -2.1557007737918865e-01 1.4674521925430977e+00 -2.0648783004287452e-01 -1.7733086765589618e-02 -1.4974008004707333e+00 3
P 4 0 2212 -0.000000000000000e+00 0.000000000000000e+00 4.9991195681135906e+01 5.000000000000000e+01 9.3827201299989860e-01 4
V -2 0 [3,4]
P 5 -2 22 -1.7166468601516022e-01 9.3744076491387351e-01 2.3581770769737886e+00 2.5434746074045371e+00 1.7377590819732251e-07 1
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P 7 2 11 2.1541096194874049e-01 -1.4663690445936359e+00 -4.7899739823468410e+00 5.0140294245396761e+00 5.10998910568335523e-04 1
P 8 2 22 1.5911542978363255e-04 -1.0831479449381629e-03 -3.5381614842558478e-03 3.7036622253238134e-03 4.1159031748919956e-11 1
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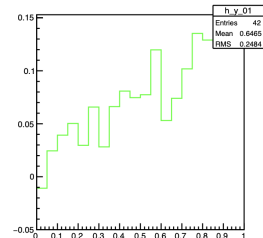
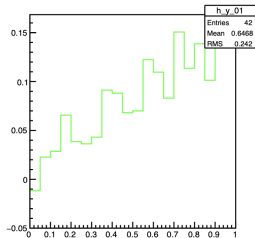
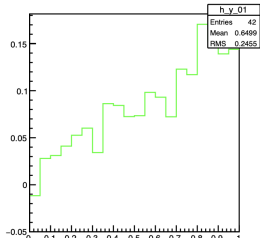
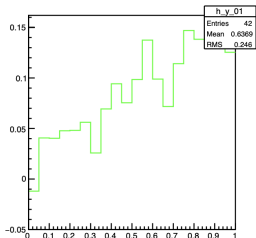
Radiative Corrections – ISR

Unpolarized target, $E_e = 5$ GeV, $E_p = 50$ GeV (Constant CFF, DVCSProcessBMJ12, $\epsilon = 10^{-7}$)



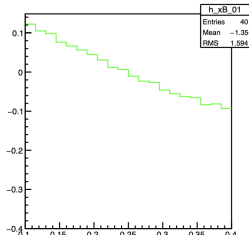
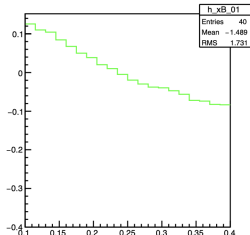
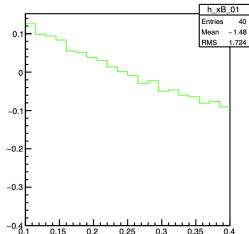
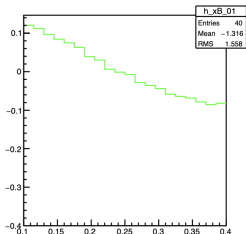
$r_c(y) - \text{ISR}$

Unpolarized target, $E_e = 5 \text{ GeV}$, $E_p = 50 \text{ GeV}$ (Constant CFF, DVCSProcessBMJ12)



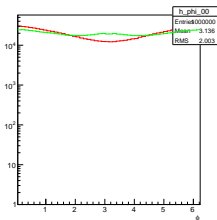
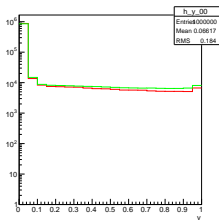
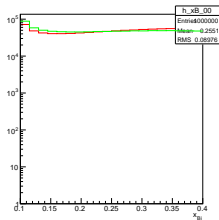
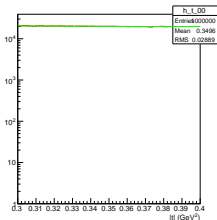
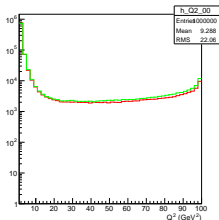
$r_c(x_B) - \text{ISR}$

Unpolarized target, $E_e = 5 \text{ GeV}$, $E_p = 50 \text{ GeV}$ (Constant CFF, DVCSProcessBMJ12)



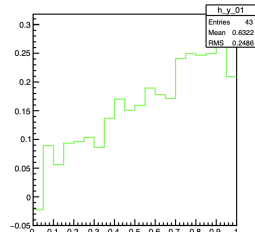
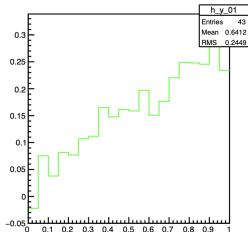
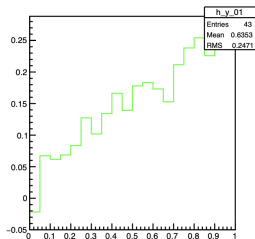
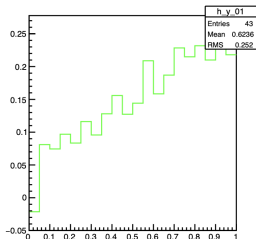
Radiative Corrections – ISR + FSR

Unpolarized target, $E_e = 5$ GeV, $E_p = 50$ GeV (Constant CFF, DVCSProcessBMJ12, $\epsilon = 10^{-7}$)



$r_c(y) - \text{ISR} + \text{FSR}$

Unpolarized target, $E_e = 5 \text{ GeV}$, $E_p = 50 \text{ GeV}$ (Constant CFF, DVCSProcessBMJ12)



$r_c(x_B) - \text{ISR} + \text{FSR}$

Unpolarized target, $E_e = 5 \text{ GeV}$, $E_p = 50 \text{ GeV}$ (Constant CFF, DVCSProcessBMJ12)

