Reduced Cross section definition

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Inclusive cross section:

$$\frac{d^2\sigma^{ep\to eX}}{dxdQ^2} = \frac{4\pi\alpha^2_{e.m.}}{xQ^4}\left[\left(1-y+\frac{y^2}{2}\right)F_2(x,Q^2) - \frac{y^2}{2}F_L(x,Q^2)\right]$$

quark+anti-quark momentum distributions

gluon momentum distribution

https://wlab.yale.edu/sites/default/files/files/Lecture1_EIC.pdf
Page 19-20

At very high energy, F3 will come into play. Here ignore the 3th order.

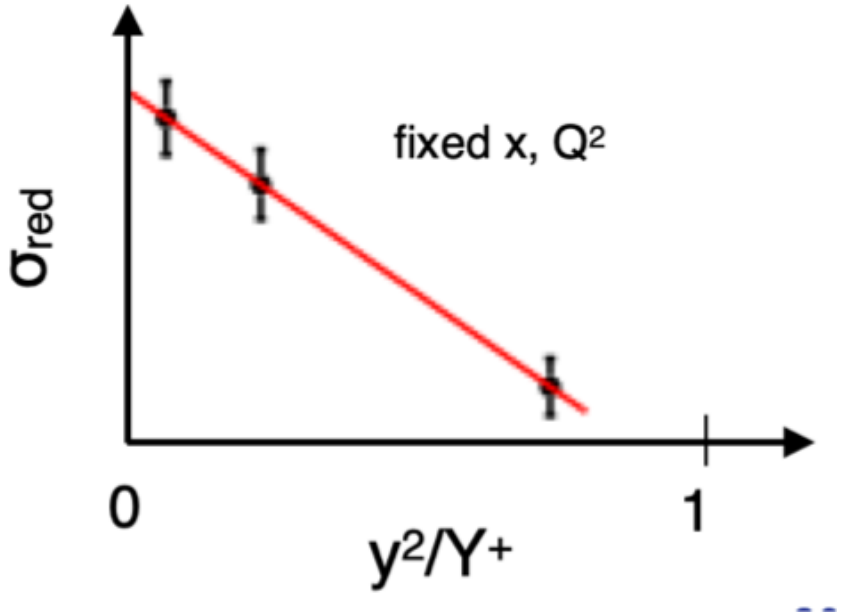
Reduced cross section

$$\sigma_r = \frac{d\sigma}{dxdQ^2} \times \frac{Q^4 x}{2\pi\alpha^2 \times (1+(1-y)^2)}$$

- Calculate the F2

$$\sigma_{\text{reduced}} = F_2(x,Q^2) - \frac{y^2}{1+(1-y)^2}F_L(x,Q^2)$$

$Y^+ = 1+(1-y)^2$



Luminosity scale

https://wiki.bnl.gov/eic/index.php/PYTHIA#Monte_Carlo_normalization

Generated luminosity:
MC Luminosity = total number of trials / total integrated cross section

Luminosity scale:
lumi-scale-factor = EIC-luminosity / generated MC luminosity

Scale the cross section error bar to the EIC luminosity:
Statistic error = statistic error from MC simulation/sqrt(lumi-scale-factor)

Reduced cross section:
https://wiki.bnl.gov/eic/index.php/Simulations#Example:_reduced_cross_section

Unit conversion:
1 h^2c^2/GeV^2= 0.3894 mb