Cross section

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Cross Section is the probability for electron to scatter

$$\frac{d^2\sigma}{dEd\theta d\phi} = \frac{1}{sin\theta}\frac{d^2\sigma}{dEd\Omega} \tag{1}$$

$$\frac{d^2\sigma}{dPd\theta d\phi} = \frac{dp}{dE}\frac{1}{sin\theta}\frac{d^2\sigma}{dEd\Omega} \tag{2}$$

where $\frac{dp}{dE} = \frac{E}{p}$ derived from $E = \sqrt{(p^2 + m^2)}$ that gives

$$\frac{d^2\sigma}{dPd\theta d\phi} = \frac{E}{p}\frac{1}{sin\theta}\frac{d^2\sigma}{dEd\Omega} \tag{3}$$

for electron in HMS, the cross section can be calculated by integral of differential cross section

$$\sigma^e_{HMS} = \int_{\Sigma_{HMS}} dE \int_{\Gamma_{HMS}} d\Omega \frac{d^2\sigma}{dEd\Omega} \tag{4}$$

where we have ideal cross section

$$\sigma_{ideal} = \delta E\delta\Omega \left(\frac{d\sigma}{dEd\Omega}\right)\Bigg|_{E_i\Omega_i} \tag{5}$$

$$\sigma_{exp} = \frac{N}{Q} \tag{6}$$

$$\begin{aligned} \frac{d\omega}{dEd\Omega} &= Y\frac{1}{\Delta E\Delta\Omega}\left(\frac{\Delta E\Delta\Omega}{\delta E\delta\Omega}\right) \\ &= Y\frac{1}{\epsilon}\frac{1}{\Delta E\Delta\Omega} \end{aligned} \tag{7}$$

Here we use $\Delta E\Delta\Omega$ as energy and solid angle acceptance in experiment phase space, $\delta E\delta\Omega$ as in ideal phase space
We use SIMC to simulate the ideal acceptance

2 Optical Theorem DIS cross section

https://en.wikipedia.org/wiki/Optical$_{t}heorem$

References

[1]