FF - search

12.10.16

(A) $G_E = (1 + \delta G_E) \cdot G_E^B$

If I use $G_E^M = (1 + \delta_M) \cdot G_E^B$ model for the form-factor, then:

These two compensate each other!!

(B) $G_E = (1 + \delta G_E) \cdot G_E^B (1 + \delta_M) = (1 + \delta G_E + \delta_M) G_E^B$

This can be an issue!

$\leq 0.5\%$

This would be an error, if another model would be used instead of Bernauer!

Transformation from CS to FF.

$$\text{Ratio} = \frac{\sigma_{Data}}{\sigma_{ISR} + \sigma_{FSR}}$$

If the Ratio is off, it is due to ~~both~~ both parts. ISR as well as FSR are shifted (if normalization is wrong)

Hence, we can not shift data (cross-section) reduction, to − 10% and expect, that algorithm will fix this automatically! If we want to blame ISR only for the discrepancy, we need to assume, that FSR is known, exact. ⇒ IN our case Bennur FF.

Is the Ref with Mc model or with Bennur?

	195	330	495	
0.2	1.00307	0.997658	1.00529	0.805995
0	1.00455 ↑ Δ = 0.00148	0.999036 ↑ Δ = 0.00138	1.00654 ↑ Δ = 0.00125	~ 1.3‰
$\bar{x}$	1.00061 ↓	1.00154 ↑	1.00493 ↓	

C

$$\cancel{R = \frac{\sigma_{Data}}{(\sigma_{ISR} + \sigma_{FSR})} = 1 = \frac{\sigma_{Data}}{\sigma_{ISR}(1+\delta_M) + \sigma_{FSR}(1+\delta_M)}}$$

$$\cancel{R + \delta = \frac{\sigma_{Data}}{\sigma_{ISR}(G_{ISR} + \delta G) + \sigma_{FSR}(G_{FSR})}}$$

$\cancel{\sigma_{ISR}}$

When multiplication is off and we assume that all goes on the expense of ISR, we have:

This is constant.

$$\sigma_{ISR}(1+\delta_M) + \cancel{\sigma_{FSR}}(1+\delta_M) = \tilde{\sigma}_{ISR} + \cancel{\sigma_{FSR}}$$

$$\tilde{\sigma}_{ISR} = \sigma_{ISR}(1+\delta_M) + \sigma_{FSR}\,\delta_M$$

$$\boxed{\Delta\sigma_{ISR} = \delta_M(\sigma_{ISR} + \sigma_{FSR})}$$

It is not only the ISR that contributes.

D

[redacted] are different.

$$1+\Delta R = \frac{\left(\sigma_{ISR}+\Delta\sigma_{ISR}+\sigma_{FSR}\right)}{\sigma_{ISR}+\sigma_{FSR}} \Leftarrow$$

This is how our approach works

$$1+\Delta R = 1 + \frac{\Delta\sigma_{ISR}}{\sigma_{ISR}+\sigma_{FSR}}$$

$$\boxed{\Delta R = \frac{\Delta\sigma_{ISR}}{\sigma_{ISR}+\sigma_{FSR}}}$$

transfer function factor, i.e. ISR/FSR.

$$\Delta G_E = F(\Delta R) \simeq a\cdot\Delta R$$

$$\boxed{\Delta G_E \simeq a\cdot\frac{\Delta\sigma_{ISR}}{\sigma_{ISR}+\sigma_{FSR}}}$$

(E)

This is a relative difference!

If normalization is different:

$$\Delta G_E = a\cdot\frac{\delta_M\cdot\left(\sigma_{ISR}+\sigma_{FSR}\right)}{\sigma_{ISR}+\sigma_{FSR}} = a\cdot\delta_M = \sim \text{const.}$$

(F)

[redacted]

$$G_E = m\left(1 - \frac{R^2}{6}Q^2 + \frac{b}{120}Q^4 - \frac{c}{5040}Q^6\right)\cdot(\Delta G_E + 1)$$

$$G_E = \tilde{m}\left(1 - \frac{R^2}{6}Q^2 + \frac{b}{120}Q^4 - \frac{c}{5040}Q^6\right)$$

$$\boxed{\tilde{m} = m\cdot(\Delta G_E + 1)} \quad (9)$$

If a = const. then only normalization changes.

Cross-section

$$\sigma = \sigma_0\left[\alpha\cdot|G_E^{ISR}|^2 + \beta|G_E^{FSR}|^2\right] \quad (4)$$

Let's change the ISR part.

$$G_E^{ISR} = G_E^0(1 + \Delta G)$$

$$\sigma + \Delta\sigma = \sigma_0\left[\alpha|G_E^{ISR}|^2(1 + 2\Delta G) + \beta|G_E^{FSR}|^2\right]$$

$$1+\frac{\Delta\sigma}{\sigma} = \frac{\sigma_0\left[\alpha\,|G_E^{ISR}|^2(1+2\Delta G)+\beta\,|G_E^{FSR}|^2\right]}{\cancel{\sigma_0}\left[\alpha\,|G_E^{ISR}|^2+\beta\,|G_E^{FSR}|^2\right]} \Rightarrow$$

$$\frac{\Delta\sigma}{\sigma} = \frac{\alpha\,|G_E^{ISR}|^2\,2\,\Delta G}{\alpha\,|G_E^{ISR}|^2+\beta\,|G_E^{FSR}|^2} =$$

$$= \frac{2\,\Delta G}{1+\frac{\beta}{\alpha}\frac{|G_E^{FSR}|^2}{|G_E^{ISR}|^2}} \qquad \mathrm{I}$$

$\frac{ISR}{FSR}$ ratio

relative change

If $\alpha \approx \beta$ and $G_E^{ISR} = G_E^{FSR} \Rightarrow \frac{\Delta\sigma}{\sigma} = \Delta G$

$$\Delta G = \frac{1}{2}\left(1+\frac{\beta}{\alpha}\frac{|G_E^{FSR}|^2}{|G_E^{ISR}|^2}\right)\frac{\Delta\sigma}{\sigma}$$

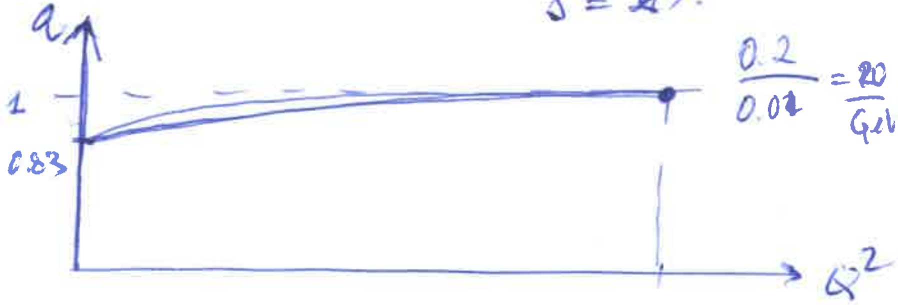
$\frac{\cancel{40}}{60} = 0.66$

$$a = \frac{1}{2}\left(1+\frac{\beta}{\alpha}\frac{|G_E^{FSR}|^2}{|G_E^{ISR}|^2}\right) = a_0 + a_1 Q^2 \qquad \mathrm{J}$$

At elastic line $\beta=\alpha$, $G_E^{FSR}=G_E^{ISR} \Rightarrow a = 1$

At the dot $\beta \le \alpha$, $\underbrace{G_E^{FSR} \le G_E^{ISR}}_{\Delta = 8\%.} \Rightarrow a \le 1$

~~[illegible]~~: $\le 20\%$



$\frac{0.2}{0.01} = \frac{20}{GeV^2}$

This matches with what we have in the algorithm

(6)

Problem: As we can see, a is not constant but change with Q^2.

Relation $\rightarrow \Delta G_E = a\,\delta_M = (a_0 + a_1 Q^2)\,\delta_M$.

K

Full Form-Factor:

$$G_E = m\left(1 - \frac{R^2}{6}Q^2 + \underbrace{\frac{b}{120}Q^4 - \frac{c}{5040}Q^6}_{\downarrow\, 0}\right)\cdot\left(1 + \Delta G_E\right)$$

For simplicity of this argument.

$$= m\left(1 - \frac{R^2}{6}Q^2\right)\cdot\left(1 + a_0\delta_M + a_1 Q^2 \delta_M\right)$$

$$\approx \cancel{m - \frac{R^2 m}{6} Q^2 + \ldots}$$

$$\approx m\left(1 - \frac{R^2}{6}Q^2 + a_0\delta_M + a_1\delta_M Q^2 - \frac{R^2 a_0 \delta_M Q^2}{6} + \ldots\right)$$

$$\approx m\left(1 + a_0\delta_M - \left[\frac{R^2}{6} - a_1\delta_M + \frac{R^2 a_0 \delta_M}{6}\right]Q^2 + \ldots\right)$$

$$\approx m\left(1 + a_0\delta_M\right)\left[1 - \left(1 - a_0\delta_M\right)\frac{R^2}{6}\left[1 - \frac{6 a_1 \delta_M}{R^2} + a_0\delta_M\right]Q^2\right]$$

L

$$\tilde{m} = m(1 + a_0 \delta_M) \quad M$$

$$\tilde{R}^2 = (1 - a_0\delta_M)\left[1 - \frac{6a_1\delta_M}{R^2} + a_0\delta_M\right] R^2$$

$$\tilde{R}^2 = R^2\left(1 - \cancel{a_0\delta_M} - \frac{6a_1\delta_M}{R^2} + \cancel{a_0\delta_M}\right) = R^2\left(1 - \frac{6a_1\delta_M}{R^2}\right)$$

$$\boxed{\tilde{R}^2 = R^2 - 6a_1\delta_M} \quad M$$

$$\left(1 - \frac{6 \cdot 20 \cdot \overset{\delta_M}{0.002} \cdot 0.2^2\,\mathrm{GeV}^2\,\mathrm{fm}^2}{\mathrm{GeV}^2 \cdot 0.77\,\mathrm{fm}^2}\right) = \left(1 - \underbrace{0.012}_{\delta R^2}\right) -$$

$$\tilde{R}^2 = R^2 \cdot (1 - \delta R^2)$$

$$\tilde{R} = R \cdot \left(1 - \tfrac{1}{2}\delta R^2\right) = R(1 - 0.006) \sim$$

In the Chi^2 minimization I am not searching for factor of the fit, but renorm. factor of the data, that brings data to 1 at limit $Q^2 \to 0$. I.e. I am determining the inverse of $\tilde{m}$.

$$\boxed{\frac{1}{\tilde{n}} \doteq \frac{1}{n}\left(1 - a_0 \delta_n\right)}$$

0

$\delta_n = 0.002, \quad a_0 \approx 0.8$

$$\Delta \frac{1}{\tilde{n}} = -a_0 \delta_n = -0.0016$$

So: If I change the normalization of the data for $\delta_n = +0.002$, then radius drops for 6%..,
And inverse normalization ~~chan~~ changes for -0.0016 !

Offset	$\frac{1}{\tilde{n}}$ 495 MeV	$\frac{1}{\tilde{n}}$ 330 MeV	$\frac{1}{\tilde{n}}$ 195 MeV	R
−0.2%	1.0078 ↑ $\Delta = 0.00126$	1.0042 ↑ $\Delta = 0.001384$	1.00605 ↑ $\Delta = 0.0015$	0.81912 ↑ $\Delta R = 0.006546$
0.0%	1.00654	0.999036	1.00455	0.812574
+0.2%	1.00529 ↓ $\Delta = -0.00125$	0.997658 ↓ $\Delta = -0.001378$	1.06307 ↓ $\Delta = -0.00148$	0.805995 ↓ $\Delta R = -0.006579$