1 Observables

There are three types of observables: CrossSetionUU, CrossSectionDifferenceLU and asymmetries -ALU, AUL, ALL.

- CrossSectionUU (σ_{UU}): Unpolarized differential cross section with both beam and target unpolarized (UU)
- CrossSectionDifferenceLU ($\Delta\sigma_{LU}$): Helicity-dependent cross section difference with a longitudinally polarized beam (L) on an unpolarized target (U). This is the difference between the cross sections for opposite beam helicities
- ALU: Beam-spin asymmetry,

$$A_{LU}(\phi) = \frac{\Delta\sigma_{LU}}{\sigma_{UU}}$$

$$A_{LU}(\phi)\cdot(\sigma^{+}+\sigma^{-}) = \sigma^{+}-\sigma^{-} = -\frac{16Ky(2-y)}{x_B y^3 \Delta^2 P_1(\phi)P_2(\phi)}\left[F_1\mathcal{H} + \frac{x_B}{2-x_B}(F_1+F_2)\tilde{\mathcal{H}} - \frac{\tilde{t}}{4M^2}F_2\mathcal{E}\right]\sin\phi \qquad \text{Ref.[2], Eq.15.}$$

- AUL: Longitudinally polarized target-spin asymmetry,

$$A_{UL}(\phi) = \frac{\Delta\sigma_{UL}}{\sigma_{UU}}$$

- ALL: Double-spin asymmetries.

Each type of asymmetry gives access to a different combination of CFFs, being mostly sensitive to one or two particular CFF(s).

Single-spin asymmetries give access to the imaginary part of the CFFs and double-spin asymmetries to their real part.

The DVCS/BH $eN \rightarrow eN\gamma$ unpolarized cross section is sensitive to both the real part and the imaginary part of the CFFs. The polarized cross section difference is linearly proportional to the imaginary part of the CFFs. [1]

1.1 CrossSectionUU

List of datasets: TKhscLcB, AtY8o7Ej, msa6dh9v, bmTzHHvg, RQncbKtk, mJXCLi4G, Cb6meE7Q, ob8hLTm2, 75ue-QoQw

The first 8 of the 9 datasets are given as "phi_dep" in the form below

x_B [none]	t [GeV^2]	Q^2 [GeV^2]	ϕ [deg]	**CrossSectionUU** [pb]	**stat** [pb]	**sys** [pb]

Table 1: The columns and the units in the dataset

y [none]	x_B [none]	t [GeV^2]	Q [GeV]	ϕ [rad]	**CrossSectionUU** (f) [nb]	**Δ f** [nb]	**pol** [none]

Table 2: The columns and the units in the GUMP file

- Some of the datasets have symmetric and some have asymmetric systematical errors. In case of asymmetric errors we took the maximum value.

- The total error-Δf is calculated as follows,

$$\Delta f = (\sqrt{\text{stat}^2 + \text{sys}^2}) \times 10^{-3}$$

- y is calculated as follows, [3]

$$x_B = \frac{Q^2}{W^2 + Q^2 - M^2}, \qquad y = \frac{W^2 + Q^2 - M^2}{s - M^2}$$

$$s = (p_l + P_h)^2 = (E_l + E_h)^2 - (\mathbf{p_l} + \mathbf{P_h})^2 = m^2 + M^2 + 2E_l E_h - 2\mathbf{p_l} \cdot \mathbf{P_h}$$

For fixed target $\mathbf{p_l} \cdot \mathbf{P_h} = \mathbf{0}$. Ignoring the lepton mass

$$s = M^2 + 2E_l E_h$$

Then

$$y = \frac{Q^2}{2\, x_B\, E_l\, E_h}$$

with given E_l and E_h in the dataset

The last file - 75ueQoQw is given as "t_dep" in the form below

nu [GeV]	$Q2$ [GeV^2]	t [GeV^2]	CrossSectionUU [nb]	**stat** [nb]	**sys** [nb]

Table 3: The columns and the units in the original file

y [none]	x_B [none]	t [GeV^2]	Q [GeV]	**CrossSectionUU** (f) [nb]	Δ **f** [nb]	**pol** [none]

Table 4: The columns and the units in the GUMP file

$$x_B = \frac{Q^2}{2M\nu}$$

$$y = \frac{Q^2}{2\, x_B\, E_l\, E_h} = \frac{M\nu}{E_l\, E_h}$$

ν is the energy of the virtual photon in the target rest frame

1.2 CrossSectionDifferenceLU

List of datasets: EqbtDRkv, nfPvTM2c, AtY8o7Ej, RQncbKtk, BJ84iv8s, EhPp8CP4

All datasets are given as "phi_dep" in the form below

x_B [none]	t [GeV^2]	Q^2 [GeV^2]	ϕ [deg]	**CrossSectionDifferenceLU** [pb]	**stat** [pb]	**sys** [pb]

Table 5: The columns and the units in the original file

The treatment is the same as the treatment for the observable CrossSectionUU.

y [none]	x_B [none]	t [GeV^2]	Q [GeV]	ϕ [rad]	**CrossSectionDifferenceLU** (f) [nb]	Δ **f** [nb]	**pol** [none]

Table 6: The columns and the units in the GUMP file

1.3 Asymmetries

List of datasets:

ALU: A6Pgo5TE, NvMm42PD, AvF5daeP, vGAKAf7P.

AUL: vGAKAf7P .

ALL:QfefWWW2, PusMstKs,vGAKAf7P

The first file A6Pgo5TE has two datasets- one is given as "Q^2" dependent and the other is given as "t" dependent. All the other datasets are given as "phi_ dep"

The treatment is same as the other observables

References

[1] H. S. Jo, PoS **QNP2012**, 052 (2012) [arXiv:1207.3709 [nucl-ex]].

[2] G. Gavalian *et al.* [CLAS], Phys. Rev. C **80**, 035206 (2009) [arXiv:0812.2950 [hep-ex]].

[3] M. Meskauskas and D. Müller, Eur. Phys. J. C **74**, no.2, 2719 (2014) [arXiv:1112.2597 [hep-ph]].