Deeply Virtual Compton Scattering at 10.6 GeV with CLAS12 at Jefferson Lab

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Deeply Virtual Compton Scattering

- GPDs appear in the DVCS amplitude through Compton Form Factors (CFF) such as:

\[ \mathcal{H} = \int_{-1}^{1} H(x, \xi, t) \left( \frac{1}{\xi - x - i\epsilon} - \frac{1}{\xi + x - i\epsilon} \right) dx \]

Generalized Partons Distributions (GPDs)

- **Tomography** of the nucleon
- Contribution of quark orbital angular momentum to the proton spin
Beam-spin asymmetry

- Extraction of GPDs from DVCS with polarized lepton beam and unpolarized target

- Photon leptoproduction beam-spin asymmetry:

\[ A_{LU} = \frac{\sigma^+ - \sigma^-}{\sigma^+ + \sigma^-} \]

- At leading order the asymmetry is:

\[ A_{LU} = \frac{A \sin(\phi)}{1 + B \cos(\phi)} \]

\[ A = \frac{s_1^T}{\kappa c_0^{BH} + c_0^T} \]

\[ B = \frac{\kappa c_1^{BH} + c_1^T}{\kappa c_0^{BH} + c_0^T} \]

combinations of CFF

\[ s_1^T \propto Im(F_1 \mathcal{H} + \xi (F_1 + F_2) \tilde{\mathcal{H}} - \frac{t}{4M^2} F_2 \mathcal{E}) \]
Selection and exclusivity cuts

Final state with:
- High energy \textbf{electron}
- High energy \textbf{photon}
- Proton
- \( Q^2 > 1 \text{ GeV}^2 \)
- \( W^2 > 4 \text{ GeV}^2 \)

Selection of exclusive DVCS events:
- \textbf{Missing mass} \( ep \rightarrow ep\gamma X \)
- \textbf{Missing energy} \( ep \rightarrow ep\gamma X \)
- \textbf{Cone angle}: angle between measured and exclusive missing photon

\( \pi^0 \) \textbf{contamination} \( ep \rightarrow ep\pi^0 \rightarrow ep\gamma\gamma \)
- Different methods have been implemented

Before exclusivity cuts

After exclusivity cuts
First look at beam-spin asymmetry

**Preliminary asymmetry:**

\[ A_{LU} = \frac{1}{P} \frac{N^+(\phi) - N^-(\phi)}{N^+(\phi) + N^-(\phi)} \]

- **P** polarization
- **\(N^+ / N^-\)** number of events with helicity + / -

- Background not yet subtracted
- Integrated over all kinematic domain (average \(Q^2 = 2.5 \text{ GeV}^2\), \(x_B = 0.22\))
Conclusion

- **Preliminary asymmetry** has been extracted

- **Less than 2% of the data** to be collected is shown here

- **Ongoing work** to study cuts, background and systematical effects

![Raw Beam-Spin Asymmetry](image)