STATUS OF DVCS ANALYSIS FROM EI-6 DATA

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Introduction & Motivation

Measurement of DVCS Cross Section, via detection of final state proton \( p' \) and lepton \( e' \).

Large statistics & broad kinematic coverage => large coverage of \( \Phi \) acceptance.

**E1-6 experiment:**

- Data collected in 2001-2002.
- Beam energy 5.754 GeV
- 5cm long liquid hydrogen target
- Average beam polarization 70%

spatial distributions of calculated photons
\( ep \) & \( ep\gamma \)
\( ep\gamma \)

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Event Selection \((e\bar{p} \ (l\gamma) \ (2\gamma) \ \text{sample})\)

Primary selection - Events with exactly one negative track with the id = 11, one positive track, any number of neutral clusters

Requirements on event vertex

Electron identification - EC fiducial cuts
  CC fiducial cuts
  DC fiducial cuts
  CC matching
  CC efficiency
  Requirements on Calo response

Proton identification - DC fiducial cuts
  Requirement on reconstructed ToF mass.

Photon identification - EC fiducial cuts
  Requirement on EC time.
  Spatial separation from charged tracks on EC.
  Minimum energy deposition in Calo.

Corrections
  Energy loss correction for electrons & protons
  Momentum & angle corrections for electrons
  Energy correction for photons
Exclusive pions \((ep(2\gamma)\) sample)

Exclusive Pion Selection: 1 electron, 1 proton & 2 photons

Kinematic requirements:

\[
W^2 > 4 \text{ [GeV}^2\text{]}
\]

\[-t < 0.52 \text{ [GeV}^2\text{]}
\]

\[-0.05 < M_X^2(epX) < 0.09 \text{ [GeV}^2\text{]}
\]

\[P_{\text{ele.}} > 0.7 \text{ [GeV]}
\]

\[P_{\pi^0} > 2.5 \text{ [GeV]}
\]

\[\text{Sector}(\gamma1) = \text{Sector}(\gamma2)
\]

MC is normalized to Data with the scale factor for

\[
\frac{N_{\pi^0}^{\text{Data}}}{N_{\pi^0}^{\text{MC}}} = \frac{9529}{135217}
\]

Same scale factor is used to evaluate exclusive pion contribution in DVCS process:

\(ep + ep\gamma\) sample

\[
N_{0,1\gamma}^{\text{Data} \pi^0}(x, Q^2, -t, \phi) = \frac{N_{\pi^0}^{\text{Data}}}{N_{\pi^0}^{\text{MC}}} N_{0,1\gamma}^{\text{MC} \pi^0}(x, Q^2, -t, \phi)
\]
Exclusive pions ($ep(2\gamma)$ sample)

Data - MC comparison exclusive $\pi^0$:

- $Q^2$ [GeV$^2$]
- $x_{Bj}$
- $\phi$ [rad]
- $W^2$ [GeV$^2$]
- $-t$ [GeV$^2$]
- $M_X^2(epX)$ [GeV$^2$]
Exclusive photons \((e^p \gamma\) sample\)

**Data - MC comparison exclusive photons:**

\[ W^2 > 4 \text{ [GeV}^2] \]
\[ 0.07 < -t < 0.52 \text{ [GeV}^2] \]
\[ |M_X^{2}(e^pX)| < 0.08 \text{ [GeV}^2] \]
\[ P_{\text{ele.}} > 0.7 \text{ [GeV]} \]
\[ t < t_{\text{min}} \]
\[ \theta_{\gamma\text{calc.}} > 2^\circ \]
Exclusive photons ($e\gamma\gamma$ sample)

Data - MC comparison exclusive photons: (exclusive $\pi^0$, DVCS, MC sum)
DVCS \((e^p + e^p \gamma)\) sample

**Exclusive Event Selection:** 1 electron, 1 proton & 0 or 1 photon

**Kinematic requirements:**

\[ W^2 > 4 \text{ [GeV}^2\text{]} \]
\[-0.07 < -t < 0.52 \text{ [GeV}^2\text{]} \]
\[|M_X^2(epX)| < 0.08 \text{ [GeV}^2\text{]} \]
\[P_{ele.} > 0.7 \text{ [GeV]} \]
\[t < t_{\text{min}} \]
\[\theta_{\gamma_{\text{calc.}}} > 2^\circ \]

**Statistics:**

739647 events

<table>
<thead>
<tr>
<th>(x_{Bj})</th>
<th>0.15-0.17</th>
<th>0.17-0.19</th>
<th>0.19-0.21</th>
<th>0.21-0.23</th>
<th>0.23-0.25</th>
<th>0.25-0.27</th>
<th>0.27-0.29</th>
<th>0.29-0.32</th>
<th>0.32-0.35</th>
<th>0.35-0.40</th>
<th>0.40-0.55</th>
</tr>
</thead>
<tbody>
<tr>
<td>(-t)</td>
<td>0.07-0.16</td>
<td>0.16-0.22</td>
<td>0.22-0.28</td>
<td>0.28-0.35</td>
<td>0.35-0.43</td>
<td>0.43-0.52</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
DVCS ($e\bar{p} + e\bar{p}\gamma$ sample)

Data - MC comparison (exclusive $\pi^0$, DVCS, MC sum):

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DVCS ($e\bar{p} + e\bar{p}γ$ sample)

Data - MC comparison (exclusive $π^0$, DVCS, MC sum):

Aram Movsisyan, DPWG meeting 30.03.2017
DVCS ($e\bar{p} + e\bar{p}\gamma$ sample)

Data - MC comparison (exclusive $\pi^0$, DVCS, MC sum):

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DVCS \((e\bar{p} + e\bar{p}\gamma\text{ sample})\)

Data - MC comparison (exclusive \(\pi^0\), DVCS, MC sum):

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DVCS \((e\rho + e\rho\gamma\text{ sample})\) X-section

\[ Bin 1 \]

\[ 0.15 < x_{Bj} < 0.17 \]

\[ Q^2 = 1.4989 \]
\[ x_{Bj} = 0.1623 \]
\[ -t = 0.1105 \]

\[ 0.15 < x_{Bj} < 0.17 \]

\[ Q^2 = 1.4982 \]
\[ x_{Bj} = 0.1625 \]
\[ -t = 0.1869 \]

\[ 0.15 < x_{Bj} < 0.17 \]

\[ Q^2 = 1.4998 \]
\[ x_{Bj} = 0.1625 \]
\[ -t = 0.2485 \]
DVCS \((e\bar{p} + e\bar{p}\gamma \text{ sample})\) X-section

**Bin21**

\[0.40 < x_{Bj} < 0.55, \quad \theta < 34^\circ\]
Comparison with Published Results

Binning Used in Published analysis.

<table>
<thead>
<tr>
<th>Bin</th>
<th>$Q^2$ Range</th>
<th>$t$ Range</th>
<th>% of Dataset</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.09 – 0.13</td>
<td>11.57%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.13 – 0.18</td>
<td>12.91%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.18 – 0.23</td>
<td>11.21%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.23 – 0.3</td>
<td>12.13%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.3 – 0.39</td>
<td>11.38%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.39 – 0.52</td>
<td>11.19%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.52 – 0.72</td>
<td>10.84%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.72 – 1.1</td>
<td>10.74%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.1 – 2.8</td>
<td>8.03%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 5: 9 bins in $t$.

Table 4: 21 bins in the ($Q^2$, $x_B$) plane defined using $x_B$ and $\phi_e$.

Kinematic coverage of e16 data with binning Used in Published analysis.

Kinematic requirements to match the conditions of Published results

$\theta_{ele} > 21^\circ$

$\theta_{ele} < 45^\circ$

$P_{ele} > 0.8 \ [GeV^2]$

$\theta_{\gamma calculated} > 5^\circ$
Comparison with Published Results

**Bin5**

$x_{Bj} - [0.17 - 0.20]$

$\theta - [25.5 - 45]$
Comparison with Published Results

Bin17

\[ x_{Bj} - [0.35 - 0.38] \]

\[ \theta - [28 - 45] \]
**Conclusion & Outlook**

a. Sufficiently good description of exclusive pion production by MC simulation allows to measure DVCS via detection of only electron and proton.
b. Further improvement of Data-MC comparison can be obtained by improved particle ID and implementation of radiative corrections.
c. Preliminary results are consistent with published CLAS data.

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a. Improve data-mc comparison.
b. Radiative Corrections.
c. Check sensitivity to background subtraction.
d. Estimation of systematic uncertainties for the measurement of cross sections.

Thank you!