UPDATE ON DVCS ANALYSIS FROM EI -6 DATA

A. Movsisyan, S. Pisano, H. Avakian





Physics Motivation

DVCS - so far the most reliable tool to access GPDs:

Example of recent results from one of the global fits to world data \Im K. Kumericki et. al. (2015): Leading $\cos(n\phi)$ moments of unpolarized cross sections (weighted by lepton propagators)



Large uncertainties in some -t bins for $cos(\phi)$ moment: partly driven by the non-complete ϕ coverage

Possible improvement can be achieved trough measurement of DVCS process via ep channel.





General Introduction

EI-6 experiment:

Data collected in 2001-2002. Electron beam energy 5.754 GeV Beam Current 7nA 5cm long liquid hydrogen target Average beam polarization 70% Torus current 3375 A Total accumulated charge 21mC

Analysis steps:

primary identification trough particle id and charge + fixed event topology (gpart=2,3,4, ep, ep γ , ep $\gamma\gamma$)

charged particle momentum correction based on mc (energy loss corrections) z-vertex correction and cuts

- fiducial volume cuts
- electron DQ cuts
- kinematic cuts + exclusivity cuts



Energy loss Correction





z Vertex Correction





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200

-2

 $^{0}_{-10}$

-8

EC Fiducial Volume



50

100 1500 2000 250503020 0352504

h

50

100

U [cm] W [cm] V [cm]

0

450 500

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50

08004595050400

U [cm] W [cm]

50

00

450 ×10³

50

100 1550 2000 2550 3600 3550 4

Sector 6 Peptor 5 le



50

240 ×10³

100 150 200 250 300 350 400 450 500

Sector 4 lepton

U [cm]

CC & DC Fiducial Volume

CC fiducial cuts:

 $|\phi_{CC}| < -66.0 + 37.0 \log(\theta_{CC}) - 1.7\theta_{CC} + 0.11\theta_{CC}^2$

 $|\theta_{CC}| < -43.0 + 0.05 |(\phi_{CC})| + 0.003 |\phi_{CC}|^2$



DC fiducial cuts:





Electron DQ cuts





Exclusive pion selection





Exclusive pion selection

180

160

140

120

100

80

60

40

20

epyy data

 $-5.00 < M_x^2 < 0.08$ $-3.00 < M_x^2 < 0.08$

 $-1.00 < M_{\star}^2 < 0.08$

 $-0.50 < M_x^2 < 0.08$ $-0.30 < M_y^2 < 0.08$

 $-0.08 < M_{\star}^2 < 0.08$

⁶ Р_{π⁰} [GeV]

6

 P_{π^0} [GeV]

5

Data

5

MC

 $ep\gamma\gamma - sample$ $W^2 > 4 \ [GeV^2]$ $P_{lepton} > 0.63884 \ [GeV]$ $10 \times N_{pe} > 25$ $-t < 0.52 \ [GeV^2]$ $-0.05 < M_x^2 (epX) < 0.09 \ [GeV^2]$ Both photons in the same sector $P_{\pi} > 2.2 \ [GeV]$





Exclusive pion selection

exclusive cuts.

 $ep\gamma\gamma - sample$ $W^2 > 4 \ [GeV^2]$ $P_{lepton} > 0.63884 \ [GeV]$ $10 \times N_{pe} > 25$ $-t < 0.52 \ [GeV^2]$ $-0.05 < M_x^2 (epX) < 0.09 \ [GeV^2]$ Both photons in the same sector $P_{\pi} > 2.2 \ [GeV]$







Distributions of N_phe in 6 sectors after applying all





















ep & epy samples: background subtraction

 $\begin{array}{l} ep \ \cup \ ep \gamma - sample \\ W^2 > 4 \ [GeV^2] \\ P_{lepton} > 0.8 \ [GeV] \\ 10 \times N_{pe} > 25 \\ - t < 0.52 \ [GeV^2] \\ - 0.08 < M_x^2(epX) < 0.08 \ [GeV^2] \\ \theta_{\gamma_{calc.}} > 1.4^{\circ} \end{array}$

Background contribution estimated from MC:

$$N_{0,1\gamma}^{Data\,\pi^{0}}(x,Q^{2},-t,\phi) = \left(\frac{N_{\pi^{0}}^{Data}}{N_{\pi^{0}}^{MC}}\right) N_{0,1\gamma(\pi^{0})}^{MC}(x,Q^{2},-t,\phi)$$

Normalization factor obtained from exclusive pion analysis:





binning & statistics

 $|M_x^2| < 0.08$ & -t<0.52 & N_{pe} >2.5 & P_{lep} >0.8





examples of ϕ distributions





Outlook

- a. Improve fiducial volume selection (remove inefficient regions).b. Improve Data-MC consistence for pions (test sensitivity to various GPP parameters).
- c. Check self-consistence of ep analysis procedure on ep_{γ} sample.
- d. Estimation of systematic uncertainties.

Thank you!

