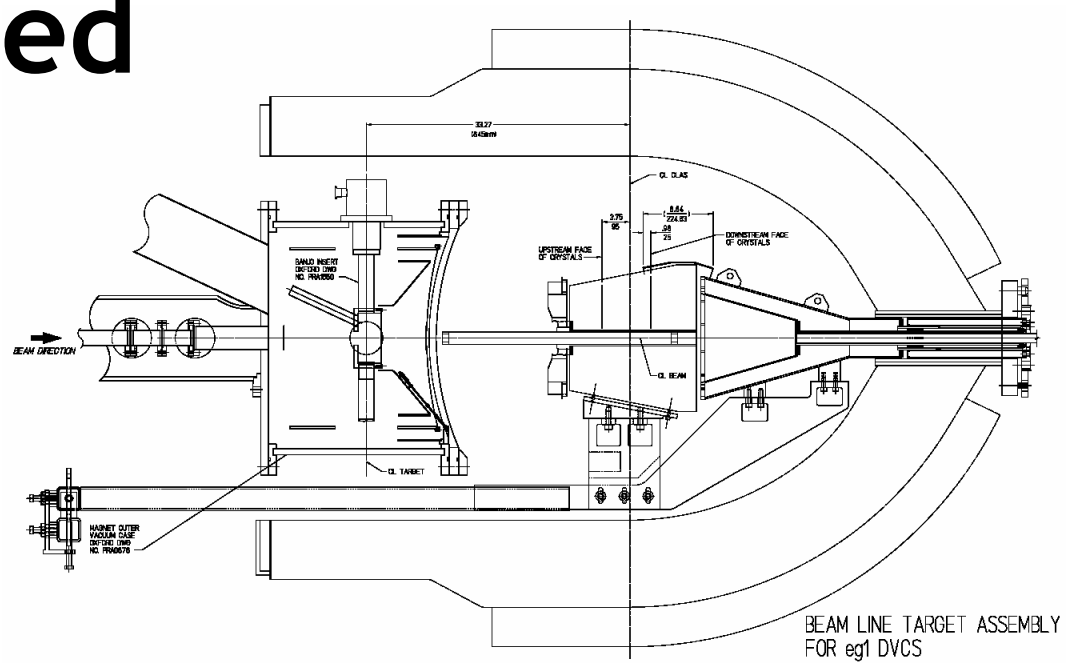
DVCS Using CLAS with Polarized Target



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Outline

- DVCS Recap
- Experimental Considerations
- Previous Data

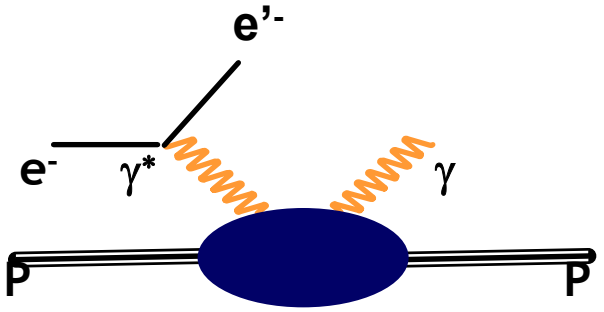
DVCS RECAP

What is DVCS?

Deeply Virtual Compton Scattering

eg1-DVCS :

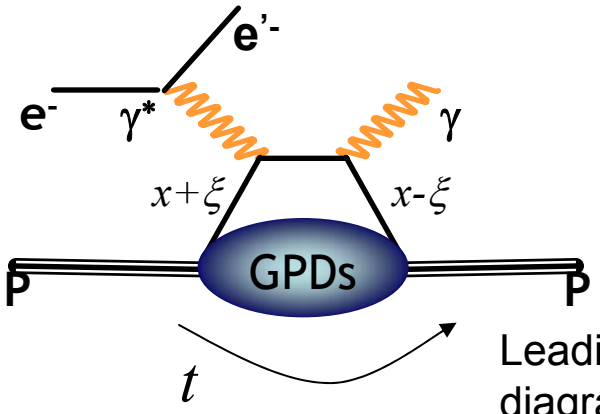
$e \vec{p} \rightarrow e' p \gamma$



Why are we interested?

Generalized **P**arton **D**istributions:

$H, \tilde{H}, E, \tilde{E}$



x – longitudinal quark momentum fraction

2ξ – longitudinal momentum transfer $\xi = x_B/(2-x_B)$

t – 4-vector momentum transfer hadronic vertex

Leading order handbag diagram contribution to DVCS

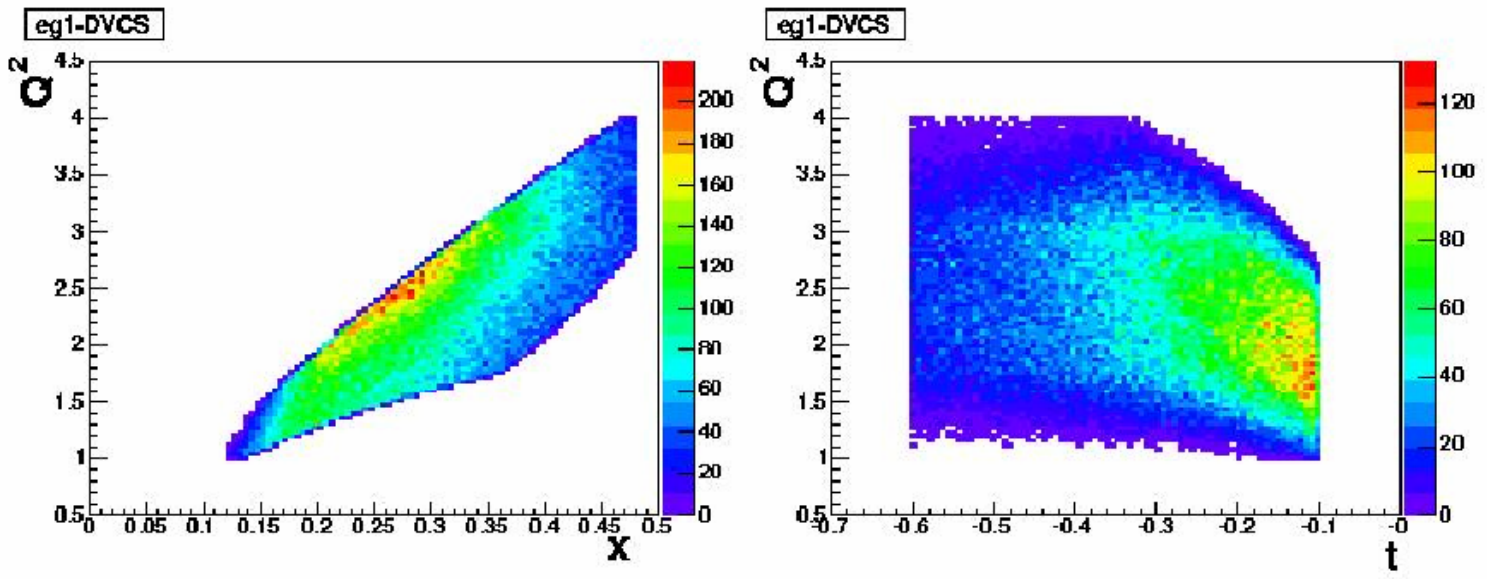
Kinematics

Generic definition of deep inelastic kinematics

$Q^2 > 1\ GeV^2/c^2$

$W > 2\ GeV/c^2$

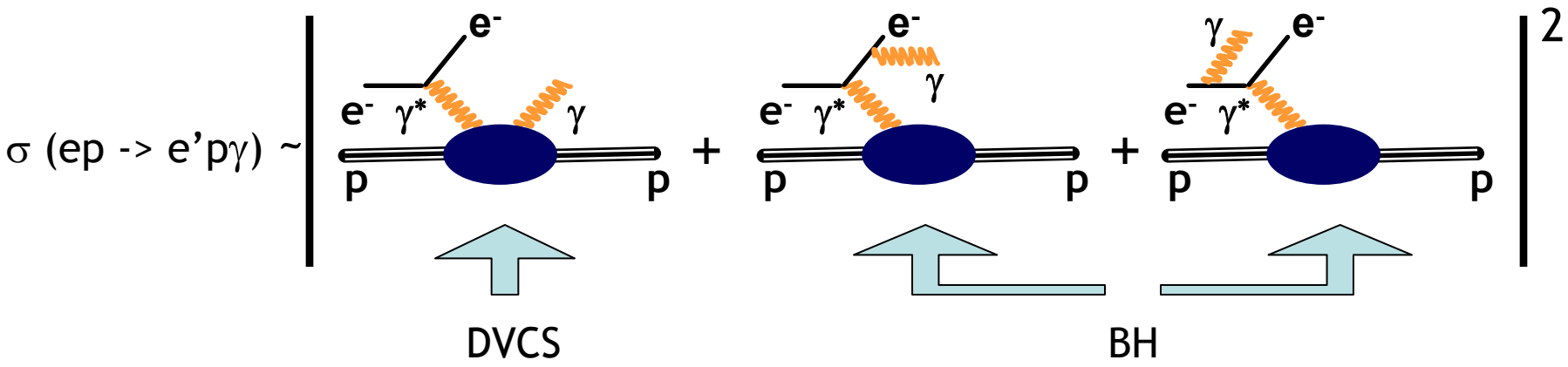
$-t < 0.6\ GeV^2/c^2$



accessible kinematic regime

Experimental Hurdle

Experimentally, DVCS is indistinguishable from Bethe-Heitler processes



BH : given by elastic form factors <- fully calculable!
DVCS: determined by GPDs

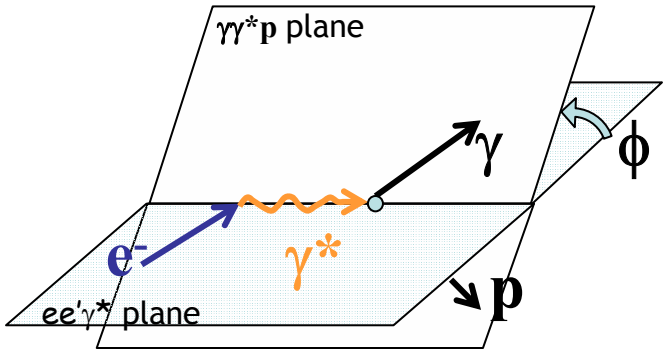
Separating GPDs

Unpolarized beam, Longitudinally polarized target:

$$A_{UL}(\varphi) = \frac{d\sigma^{\Uparrow} - d\sigma^{\Downarrow}}{d\sigma^{\Uparrow} + d\sigma^{\Downarrow}} = \frac{\Delta\sigma}{2\sigma}$$

- Up and down arrows correspond to the target spin polarizations antiparallel/parallel to the beam direction

$$A_{UL}(\varphi) \propto \left\{ F_1 \tilde{H} + \xi(F_1+F_2)\left(H + \frac{\xi}{1+\xi} E\right) + -\xi\left(\frac{\xi}{1+\xi} F_1 + \frac{1}{4M^2} F_2\right)\tilde{E} \right\} \sin\phi$$



What We Measure

$$A_{UL}(\varphi) = \frac{N^{\Uparrow}(\varphi) - N^{\Downarrow}(\varphi)}{f \bullet (P_t^{\Downarrow} N^{\Uparrow}(\varphi) + P_t^{\Uparrow} N^{\Downarrow}(\varphi))}$$

$N^{\Uparrow}$ and $N^{\Downarrow}$ – Number of $e\,p \rightarrow e'\,p\,\gamma$ events with positive and negative target helicity

$P_t^{\Uparrow}$ and $P_t^{\Downarrow}$ - corresponding absolute values of target polarizations

f – dilution factor $\frac{N_H}{N_{NH_3}}$

Improving Signal to Noise

Select events with exactly one electron (trigger), proton and photon

Suppress background events

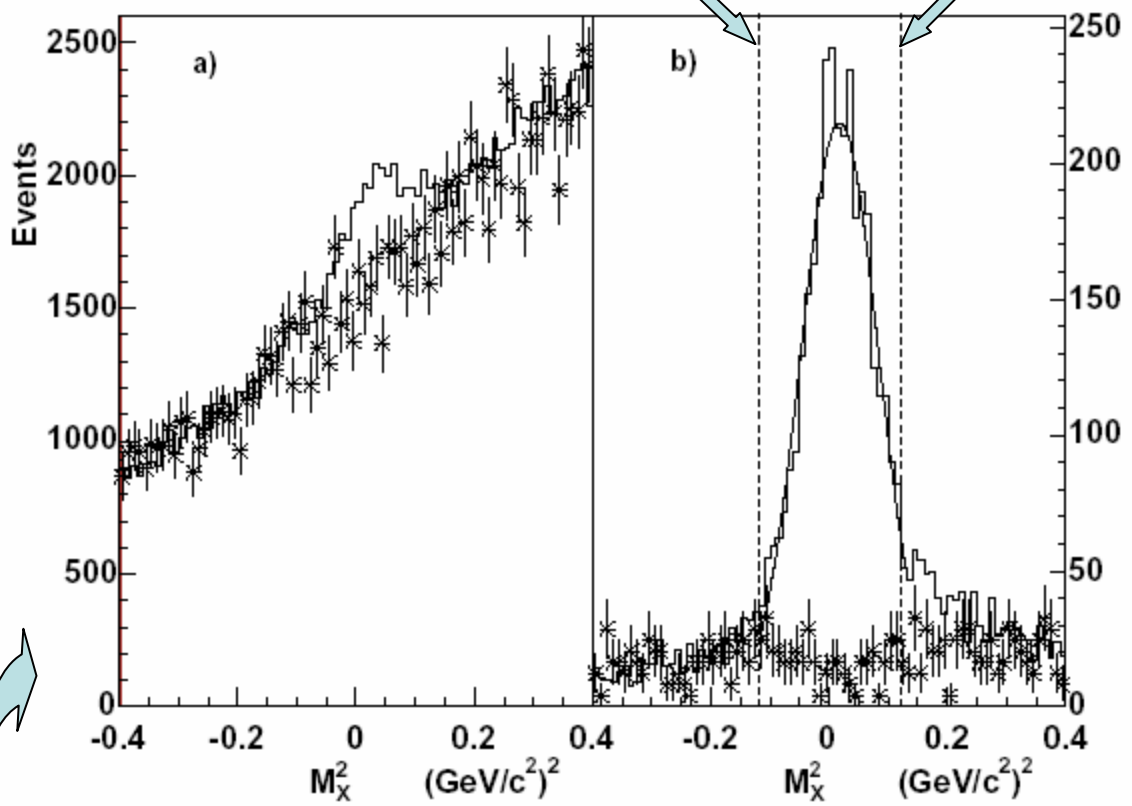
- Most events are from reactions with ^{15}N in the $^{15}NH_3$ target
- Background from ep -> e'pπ^0 events where only 1 photon from the π^0 decay was detected

Require the detected photon to be within $\theta_{\gamma X}$ of the photon angle predicted from the observed scattered e' p - defined based on Monte Carlo study

Previous Data

$M_{ep} - M_{\gamma e'pX} = M_{\gamma X}$

$-0.12\ (GeV/c^2)^2 < M_{\gamma X}^2 < 0.12\ (GeV/c^2)^2$



before cut

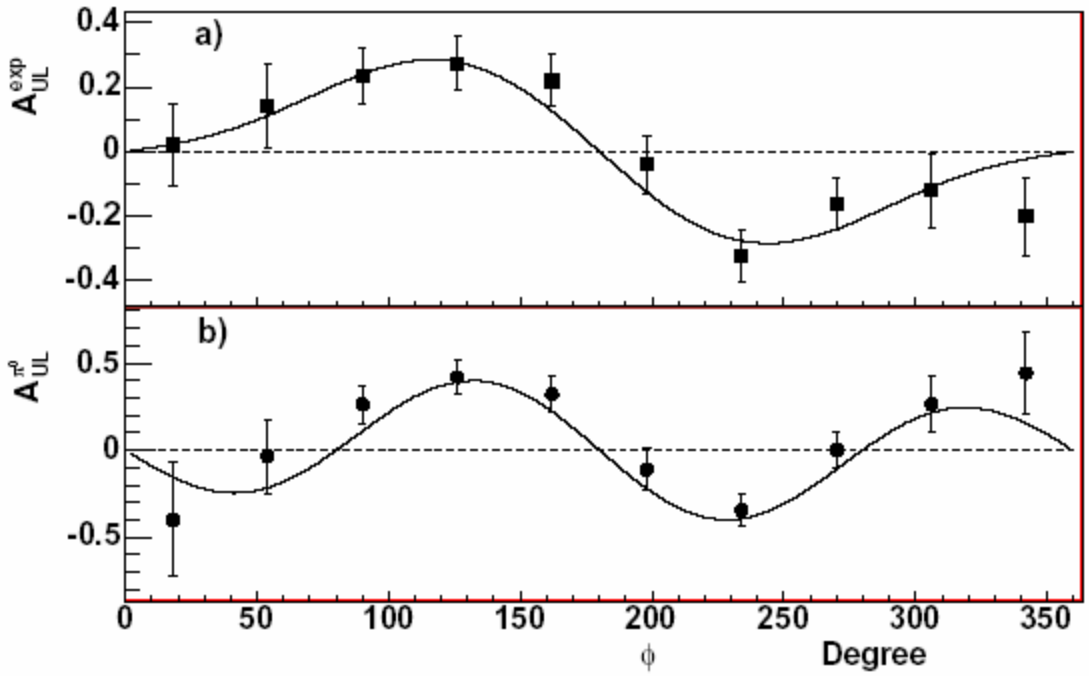
after the cut

$\theta_{\gamma X} < 2^o$

S. Chen et al. (The CLAS Collaboration), Phys. Rev. Lett. 97, 072002 (2006). (hep-ex/0605012)

Previous Data

Residual π^o Contamination



A_{UL} measured after $\theta_{\gamma X}$ cut
Large sin φ dependence

A_{UL} of π^o events
Large sin 2φ dependence

$$A_{UL}^{Exp}(\varphi) = (1 - F_{\pi^o})A_{UL}(\varphi) + F_{\pi^o} A_{UL}^{\pi^o}(\varphi)$$

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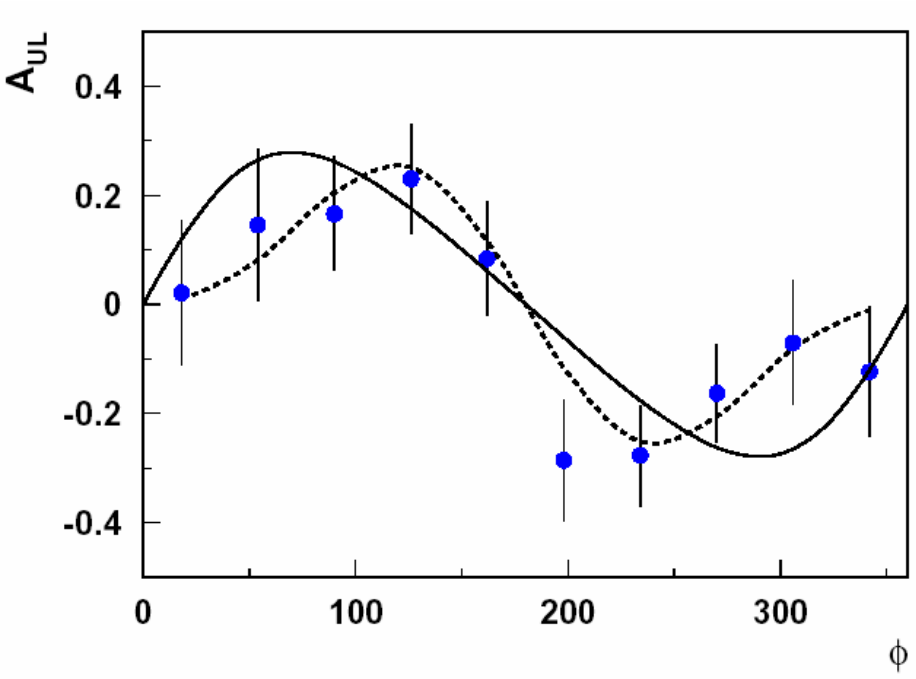
Previous Data

Handbag dominance
In Bjorken regime

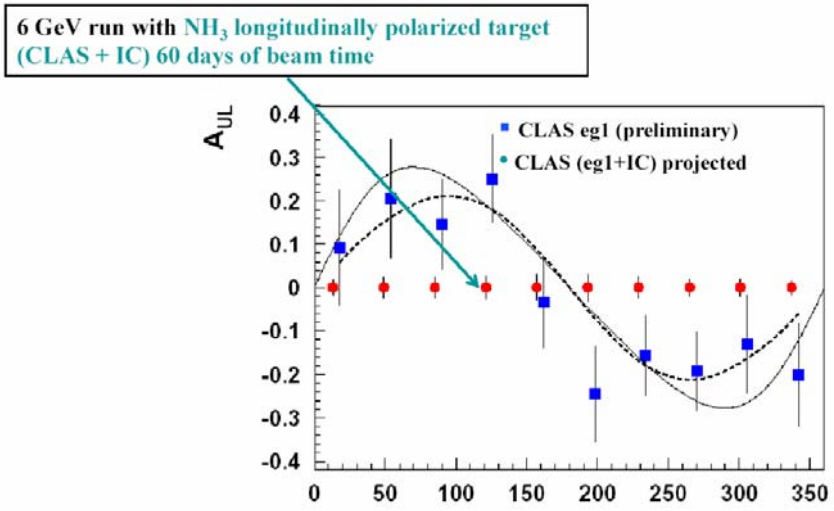


$$--- F(\varphi) = \frac{A \sin(\varphi) + \cancel{B} \sin(2\varphi)}{1 + C \cos(\varphi)}$$

0

A = 0.237±0.031
B = 0.02±0.02

— GPD-model prediction



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