

DVEP Cross Sections Roadmap



January 24, 2020
MIT-UConn Analysis Meeting

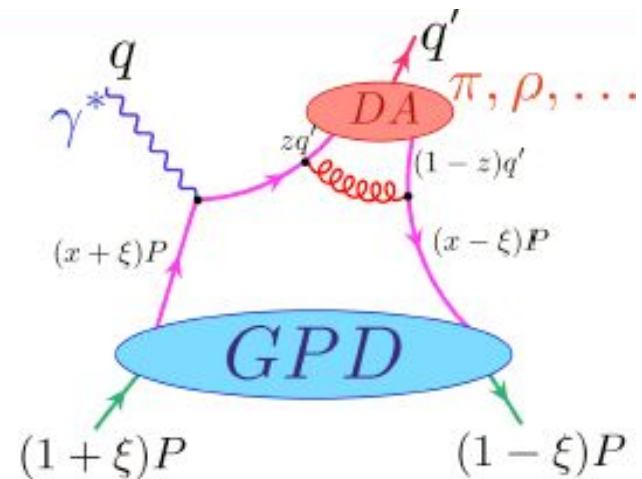
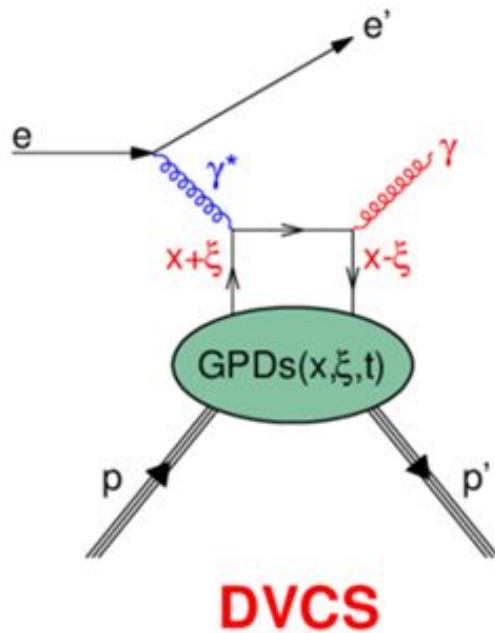
R. Johnston, S. Lee, P. Moran

DVEP Cross Sections

DVCS Cross Section - Sangbaek

Deeply Virtual Phi Production - Patrick

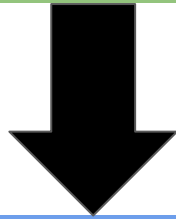
Deeply Virtual Pion Production - Bobby



DVEP Cross Section Path

(1) Understanding Raw Data

- Detector efficiencies etc.
- Luminosity measurement
- PID algorithms
- Which subset of data to use



(2) Physics Analysis

- Kinematic fitting
- Multi-dimensional binning
- Radiative Corrections
- Monte Carlo
-

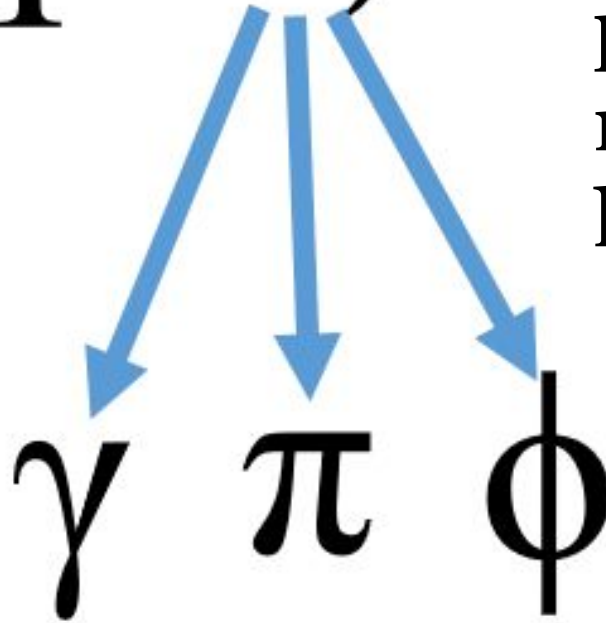


Results

- Much work to be done on (1), but the desire is to work on (1) and (2) simultaneously and iteratively; understand limiting parts of whole analysis scheme
- Working to find a reasonable path through (1) to get first order results out in the near future

The 3 Channels Share Common Structure

$$p(e, e' p X)$$



All need to identify electron, proton, have measure of luminosity, etc.

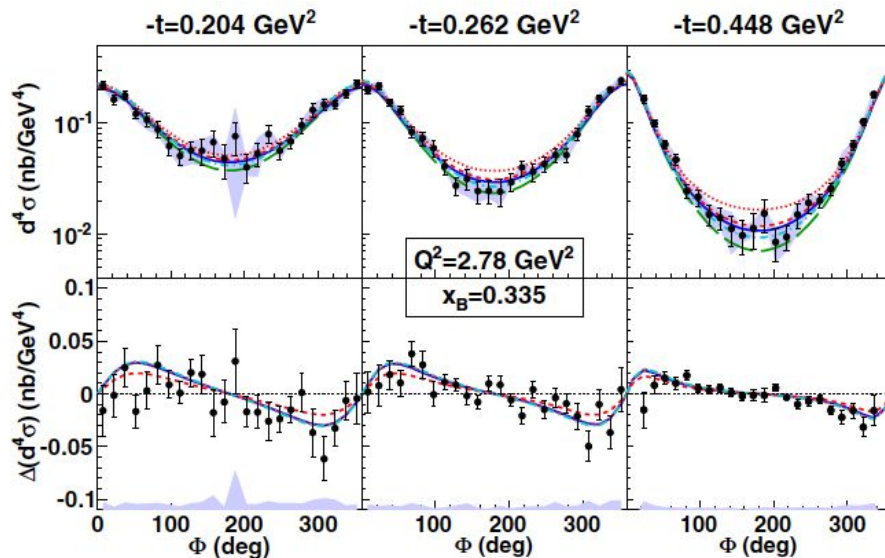
DVCS Cross Section Path

Previous Results (cross sections)

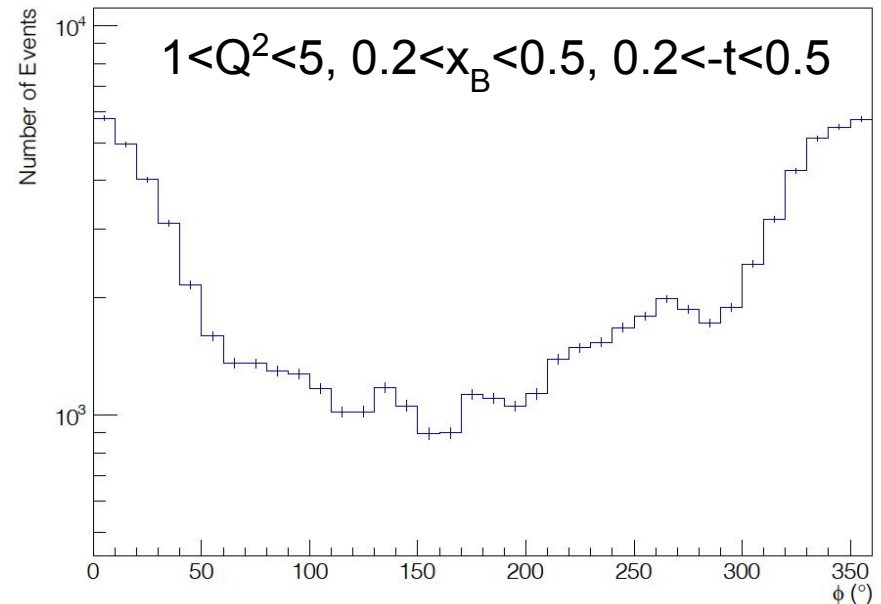
Hall A, Phys. Rev. C 92, 055202 (2015)

CLAS, Phys. Rev. Lett. **115**, 212003 (2015)

+ Analysis note




DVCS cross section (rg-a train)



DV ϕ P Analysis Goals

- Measure $\sigma(Q^2, W)$
- Measure $d\sigma/dt'$
- Extract R and σ_L from angular distributions

$$\sigma(Q^2, W, E_{beam}) = \frac{1}{\Gamma(Q^2, W, E_e)} \frac{d\sigma_\phi}{dQ^2 dW}$$

$$\frac{d\sigma}{dQ^2 dW} = \frac{1}{BR_{\phi \rightarrow K+K^-} \mathcal{L}_{int} \Delta Q^2 \Delta W} n_W$$


DV ϕ P Cross Section Path

- Electron PID
- Fiducial Cuts
- Hadron PID
- Momentum and energy loss correction
- Eliminate hyperon background
- Acceptance Corrections
- Radiative Corrections

DV π P Cross Section Path

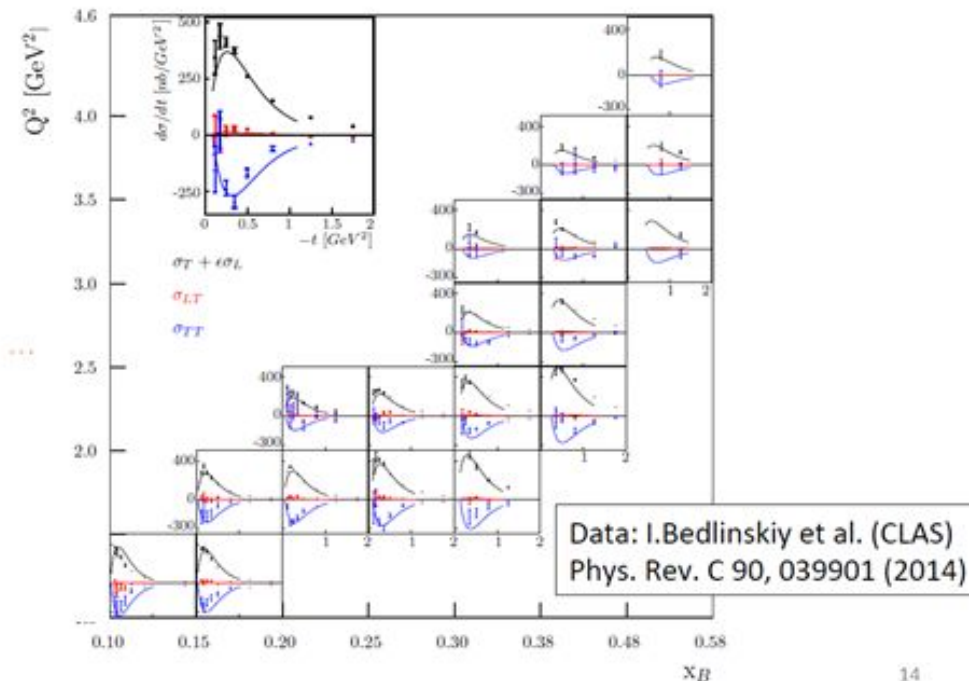
Particles:

Outgoing electron - detected as in DVCS, DV ϕ P
Proton - detected as in DVCS, DV ϕ P
Pion - Reconstructed from photons
Photons - detected as in DVCS

$$p(e, e' p \pi)$$

Physics:

- **Kinematic Fitting / Exclusivity cuts**
- **Monte Carlo:** aao_rad



Infrastructure Set Up for Collaborative Work

- Github repo, Slack, and Google Drive for collaboration
- Hope to resume normal meetings as in Summer 2019



CLAS12 Cross Sections

	A	B	C	D
1	Electron			
2				
3		PID		
4		Efficiencies		
5		Fiducial Cuts on detector volumes	calorimeter u, v, w	DC
6		Nphe		
7		min Edep		
8		V_z vertex cut		
9				
10				
11				
12				

drewkenjo / analysis_code

Code Issues Pull requests Actions Projects Wiki Security Insights

analysis code for CLAS12 data using Groovy

57 commits 2 branches 0 packages 0 releases 3 contributors

Branch: master New pull request Create new file Upload files Find file Clone or download

drewkenjo Merge pull request #12 from dmrisher/master Latest commit 0ba147f on Dec 16, 2019

.idea	Updated calo layer defs	last month
event	Updated calo layer defs	last month
examples	elpid wrapper and kin calculator and updated el cut	4 months ago
exclusive	move epkpk to examples	5 months ago
mon	electron mon and util class	4 months ago
pid	Merge pull request #11 from dmrisher/master	3 months ago
utils	removing tilda files	4 months ago
README.md	Update README.md	6 months ago
test.groovy	added epkpk channel and test file that feeds event to processors in ...	5 months ago

Mechanisms to Cross-Check Work

- Symmetry across 6 detector sectors
- Time dependence of data
- Elastic scattering (well known)
- Elastic DIS (well known)

Wrap Up

- Hoping to resume normal analysis meetings (bi-/weekly?)
- Develop Helicity Amplitude Grid
- Plan to work intensively for next two months, share progress at next group meeting (at JLab?)

Backup Slides

MC Event Generator

Generally,

- simulate N points randomly over phase space

- accept/ reject based on “weights”, i.e., differential cross sections

- if $(\text{weight}) < (\text{maximal weight}) * (\text{random number})$, reject

- whole processes can be optimized by better sampling algorithm

DVCS

- dvcsgen and genepi from gpd data

- DVCS cross section 4 fold (5 fold with degeneracy for unpol. target)

- dvcsgen gets maximal weight by non-probabilistic sampling (center of bin)

DVEP Cross Sections

5 fold cross sections: x_B , Q^2 , t , ϕ_e , ϕ_γ

ϕ_e and ϕ_γ correlated unless transversely pol.

hydrogen target is unpol., so 4 fold cross sections

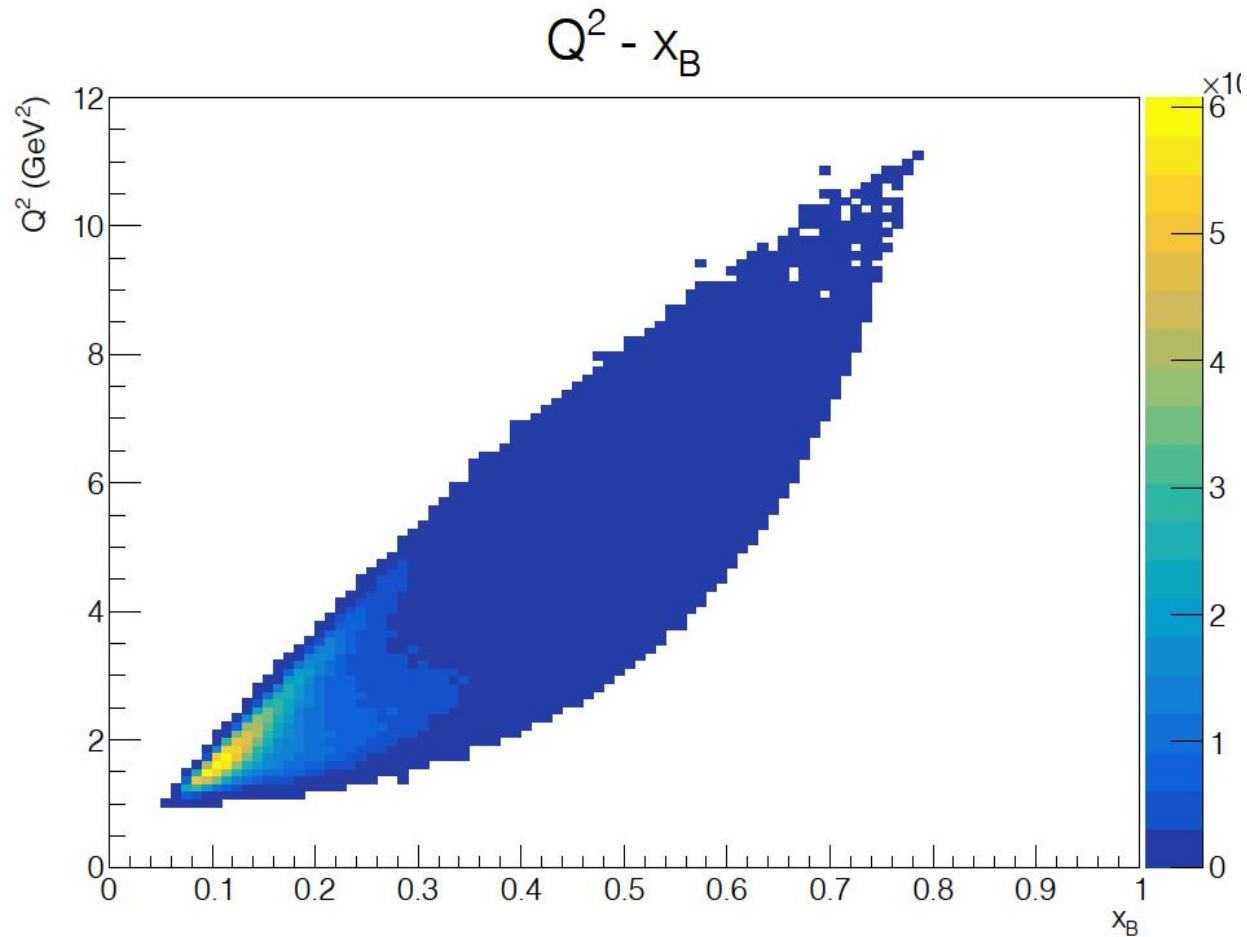
No TH4F due to memory issue -> need nice binning

-> hard to MC integrate to get cross sections

-> hard to estimate event rates, treat the data

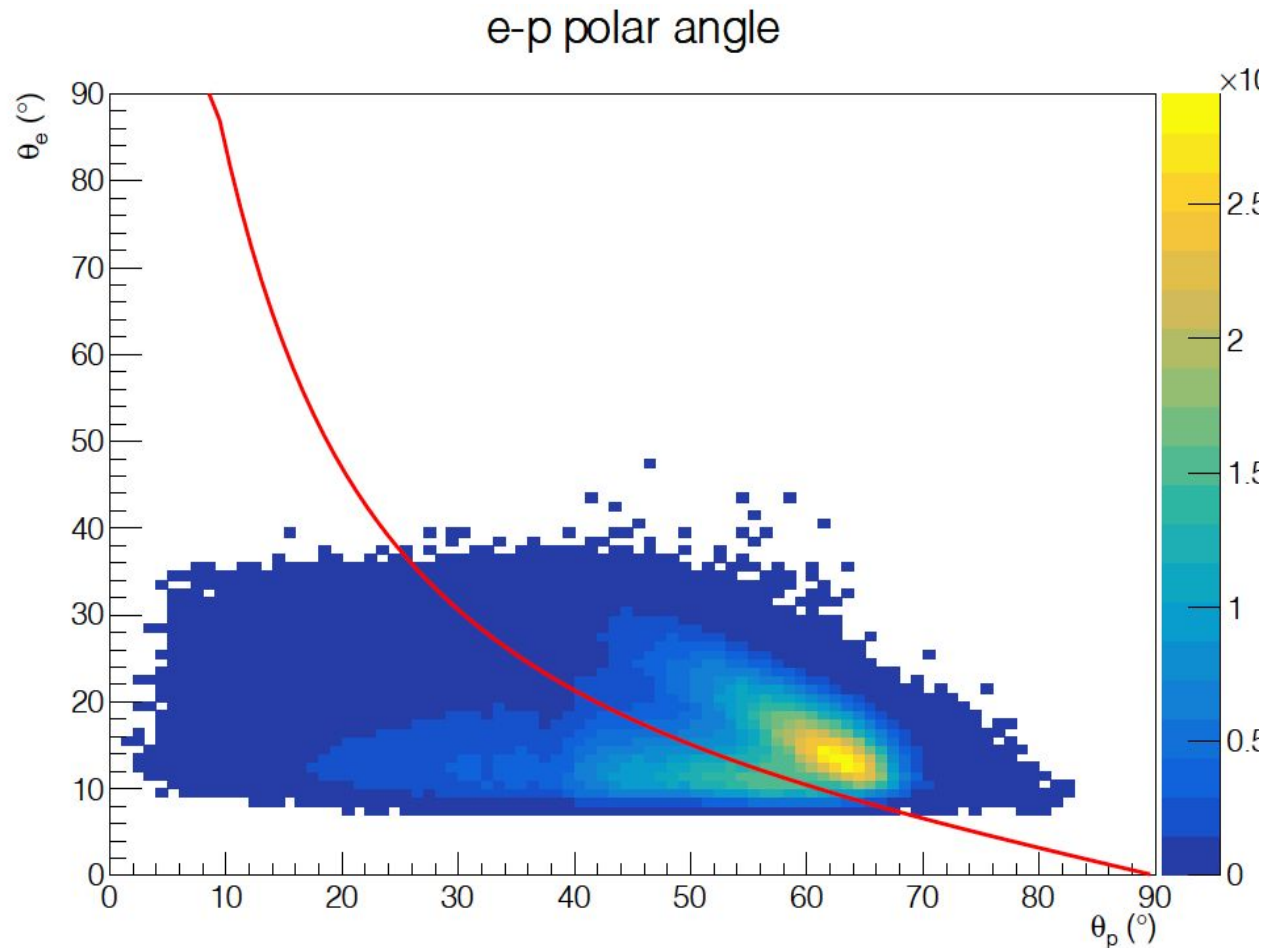
DVCS from rg-a train

$1 < Q^2 < 5$, $0.2 < x_B < 0.5$, $0.2 < -t < 0.5$



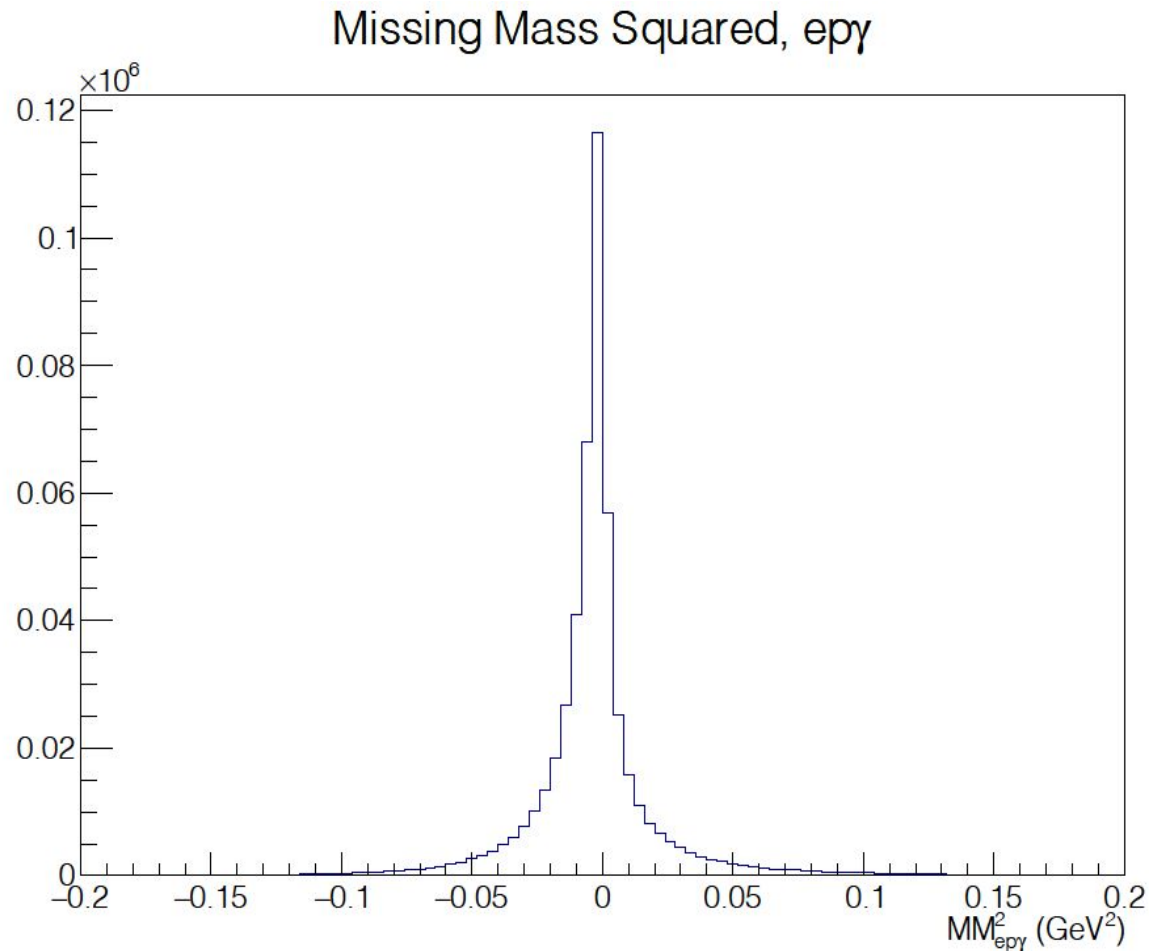
DVCS from rg-a train

$$1 < Q^2 < 5, \quad 0.2 < x_B < 0.5, \quad 0.2 < -t < 0.5$$



DVCS from rg-a train

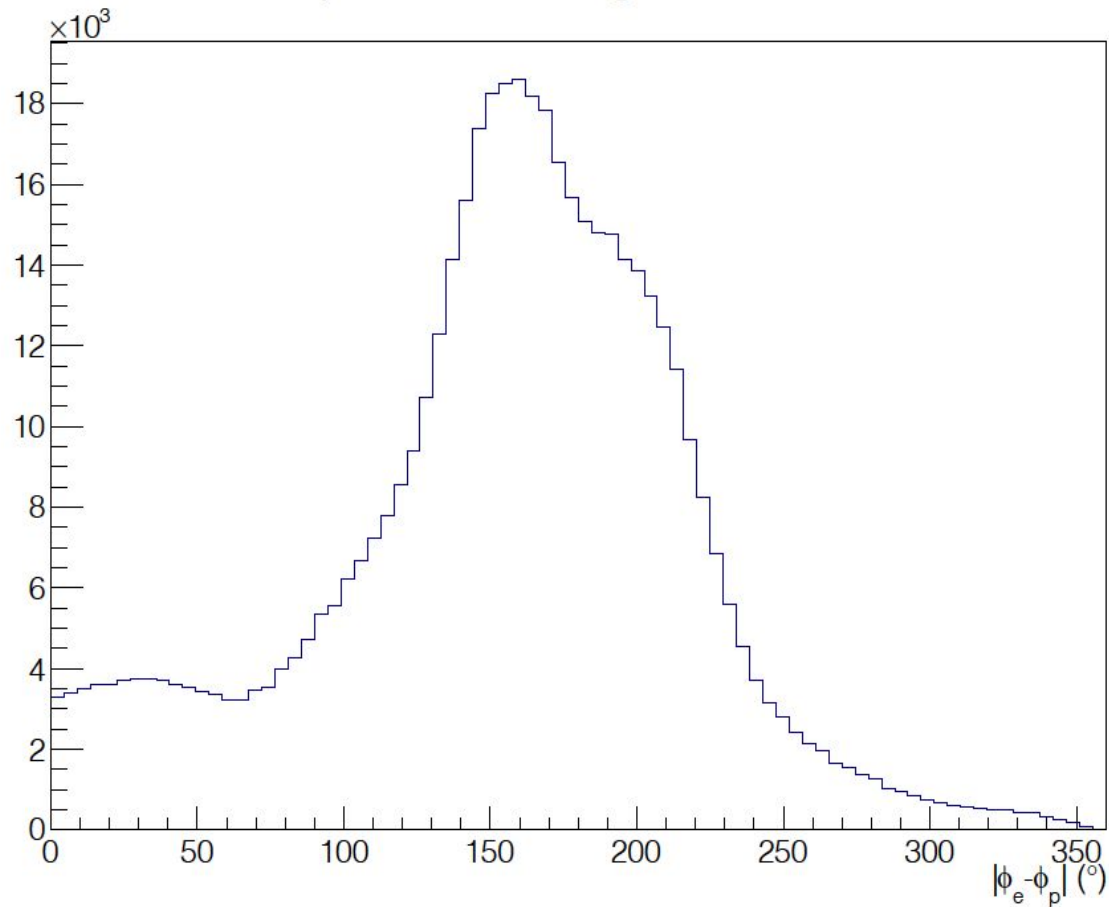
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DVCS from rg-a train

$1 < Q^2 < 5$, $0.2 < x_B < 0.5$, $0.2 < -t < 0.5$

e-p azimuthal angle difference



Backup Slides

$p(e, e'p\pi)$

$p(e, e'p\gamma)$

$p(e, e'p\phi)$