



U.S. DEPARTMENT OF
ENERGY



RG-K DVCS at 7.5 GeV

RG-K skim8:

7.546 GeV Beam, 20~50 nA Current, Liquid H₂ Target, +1/-1 Torus/Solenoid

Simulation: GEMC 4.3.0 for 200,000 DVCS and 200,000 DV $\pi^{\uparrow 0}$ P Events

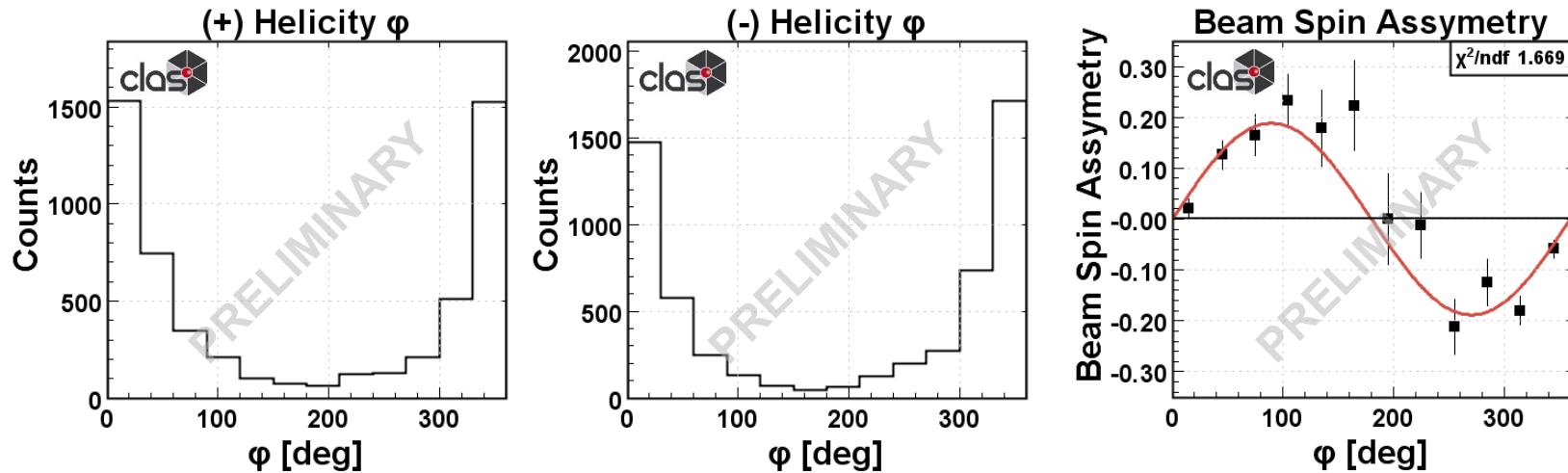
Reconstruction: CLARA 5.7.4

Skimming Requirements: 1 FD e , 1 p , and 1 γ

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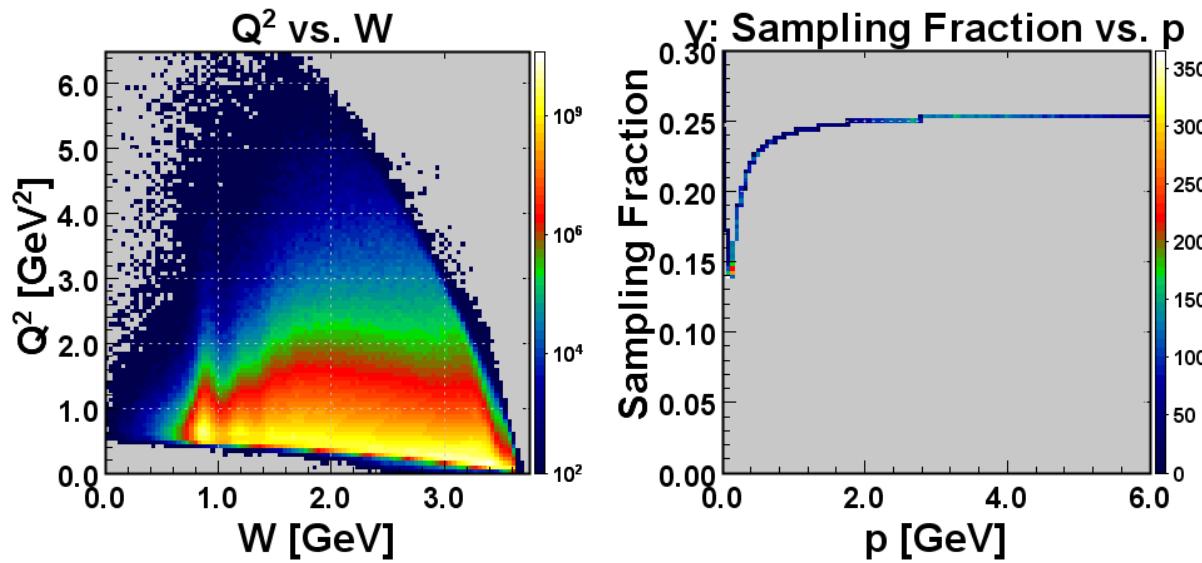
DVCS at 6.4 GeV from 2018 Spring RG-A

Results from 1% of the approved 6.4 GeV beam time, integrated over all bins, and fitted with $BSA = A \downarrow LU \uparrow \sin\phi \sin\phi / 1 + A \downarrow LU \uparrow \cos\phi \cos\phi$ showing statistical errors (only)



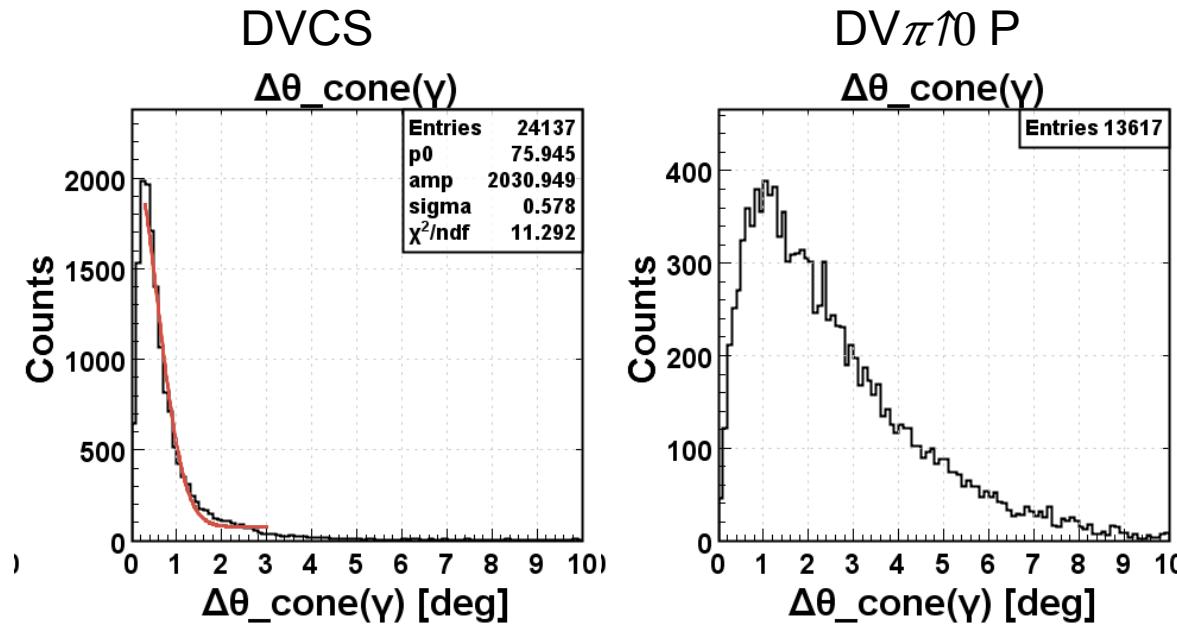
Beam spin asymmetry fit with $Q^2 > 1 \text{ GeV}^2$, $W > 2 \text{ GeV}$, $|q^\uparrow| > 2 \text{ GeV}$, $\Delta\theta_{\text{cone}}(\gamma) < 6^\circ$, and $E \downarrow X \downarrow e \uparrow p \uparrow \gamma < 0.5 \text{ GeV}$ is qualitatively in agreement with the previous CLAS DVCS results.

DVCS and DV $_{\pi^{\prime\prime}0}$ P Separation at 7.5 GeV



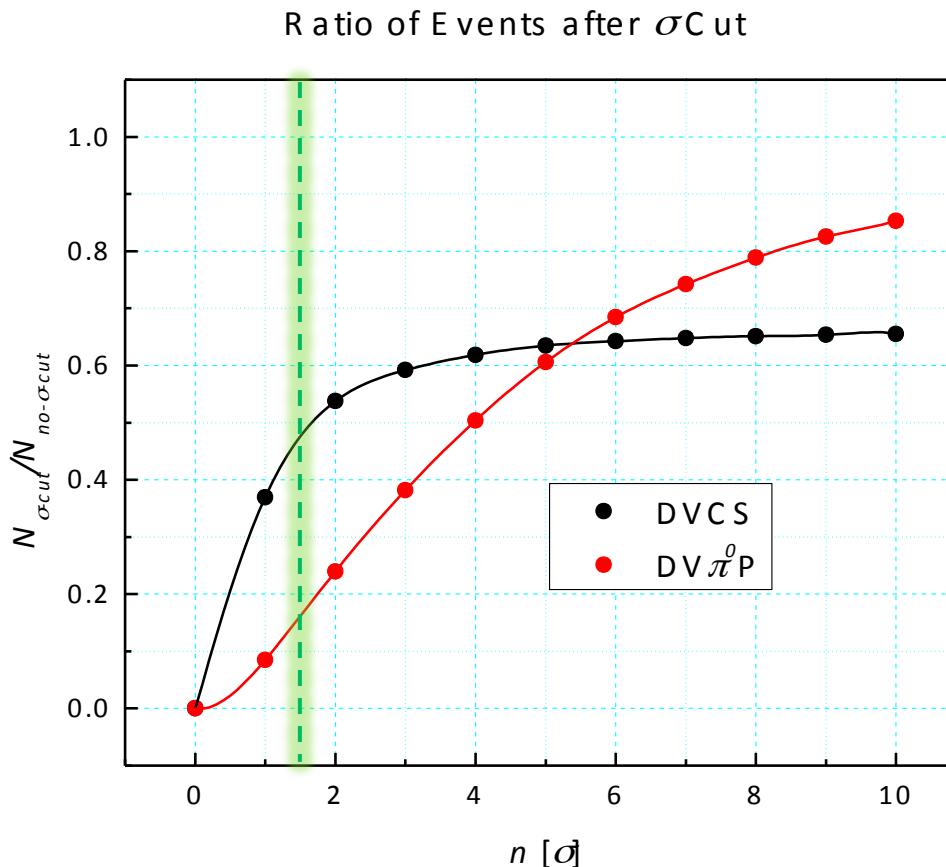
Loose cuts were initially considered: $Q^{12} > 0.5 \text{ GeV}^2$, $W > 0 \text{ GeV}$, and $|q^{\prime\prime}| > 0.3 \text{ GeV}$.

$\Delta\theta_{\text{cone}}(\gamma)$ Cut

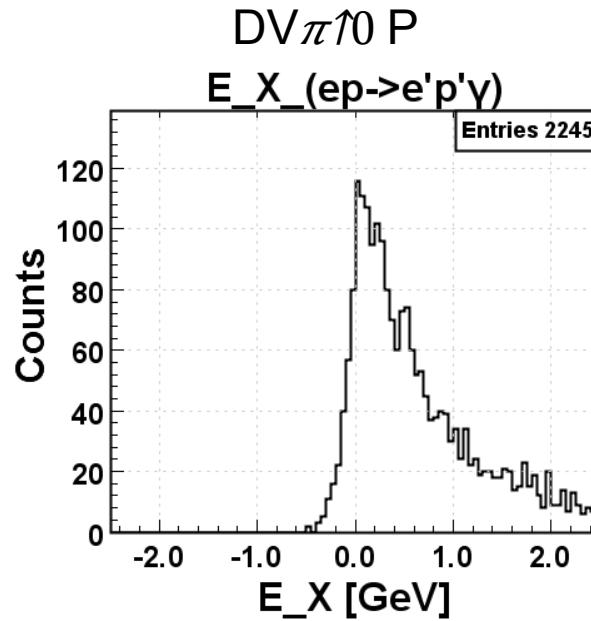
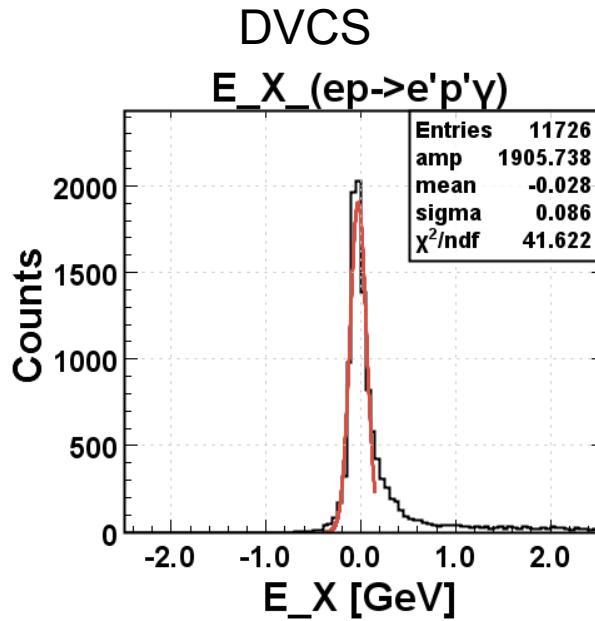


The fit of $\Delta\theta_{\text{cone}}(\gamma) = \cos^{-1}(\mathbf{q}\gamma \cdot \mathbf{X}\gamma / |\mathbf{q}\gamma| |\mathbf{X}\gamma|)$ histogram with the mean fixed at 0° gives σ of 0.58° .

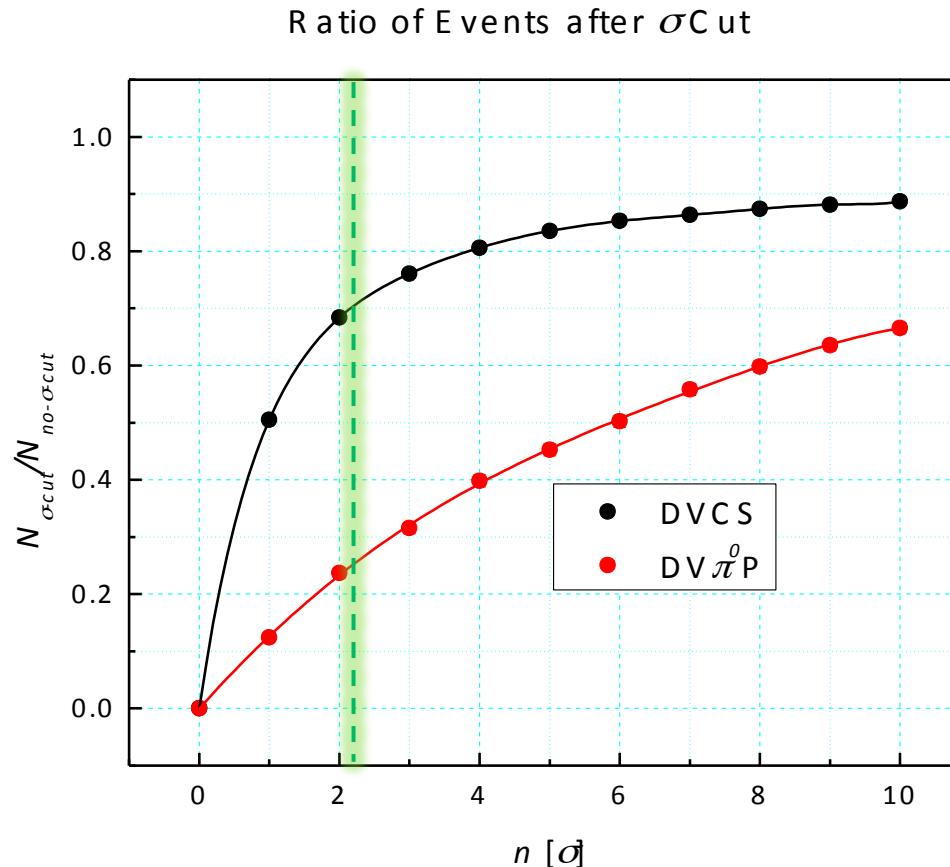
$\Delta\theta \downarrow \text{cone}(\gamma)$ Cut



Below 1.5σ cut DVCS drops faster than DV π^0 P. At this cut, DVCS drops to 48.5 % while DV π^0 P drops to 16.5%.

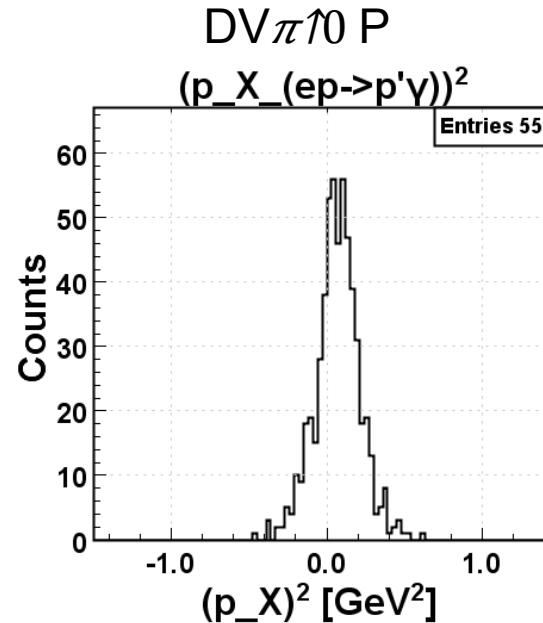
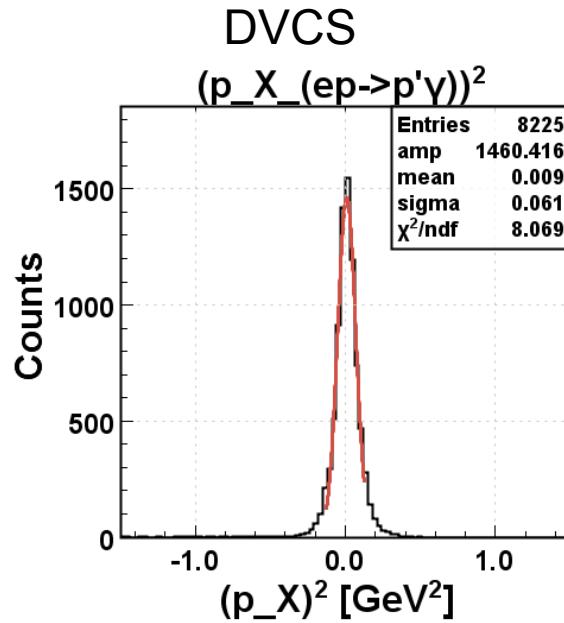


The fit of $E \downarrow X \downarrow e \uparrow p \uparrow \gamma$ histogram for DVCS gives mean of -0.028 GeV and σ of 0.086 GeV.



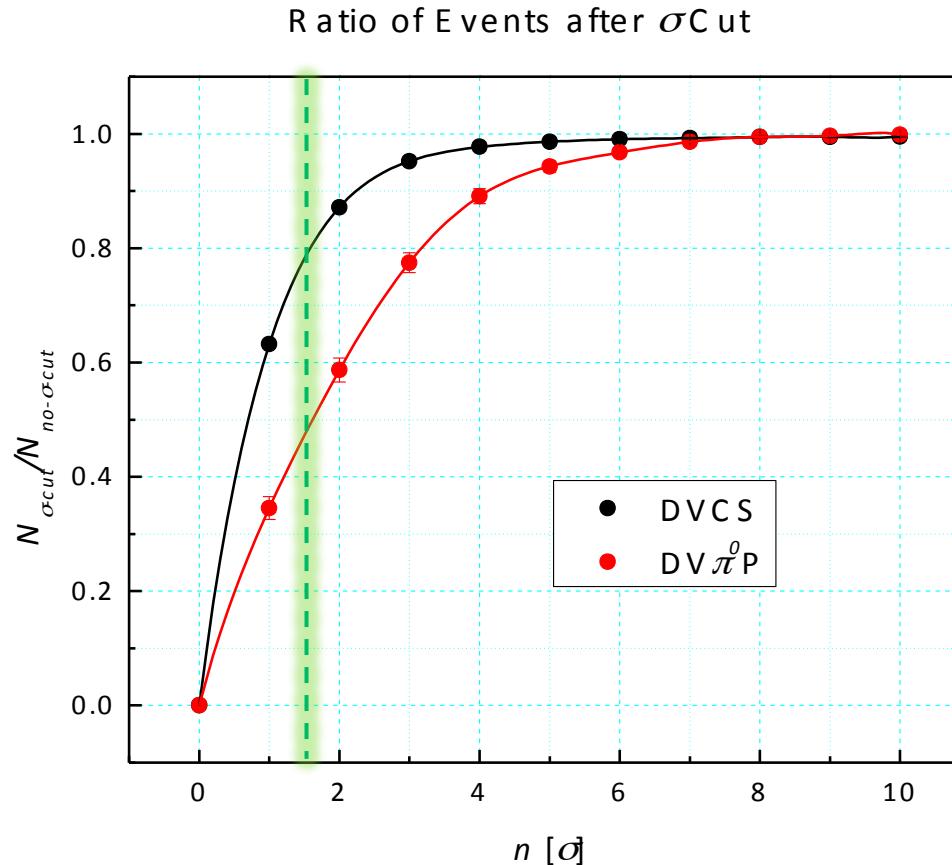
Below 2.2σ cut DVCS drops faster than DV π^0 P. At this cut, DVCS drops to 70.1% while DV π^0 P drops to 24.9%.

$p\gamma\gamma$ Missing Mass-Squared Cut



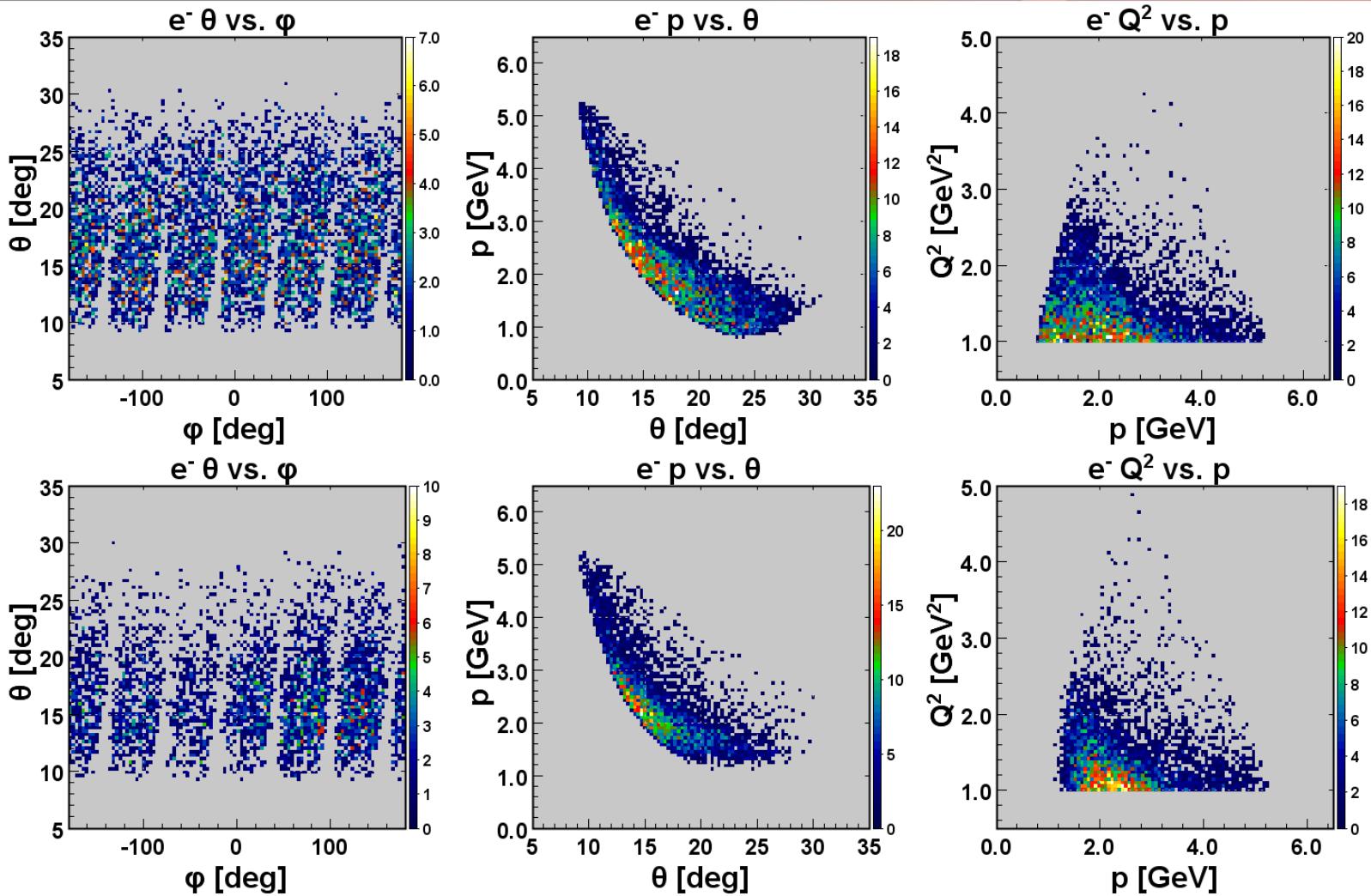
$p\gamma\gamma$ missing mass-squared of DV $\pi\gamma\gamma$ P contaminants has wider distribution shifted to the right. The fit of $p\gamma\gamma$ missing mass-squared histogram for DVCS gives me an of 0.009 GeV^2 and σ of 0.061 GeV^2 .

$p\gamma\gamma$ Missing Mass-Squared Cut



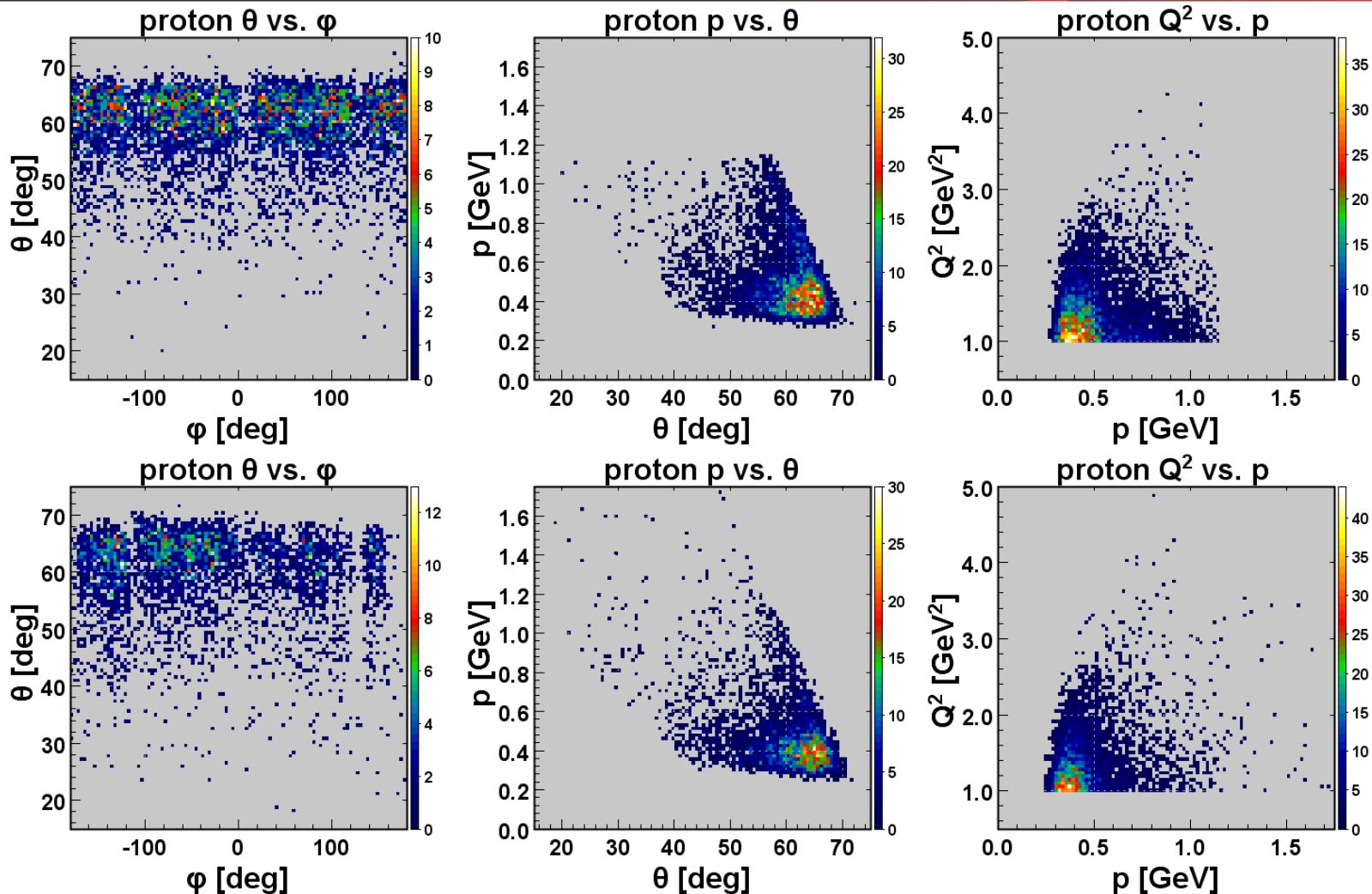
Below 1.5σ cut DVCS drops faster than DV π^0 P. At this cut, DVCS drops to 76.3% while DV π^0 P drops to 44.9%.

DVCS $e\gamma$ Kinematics



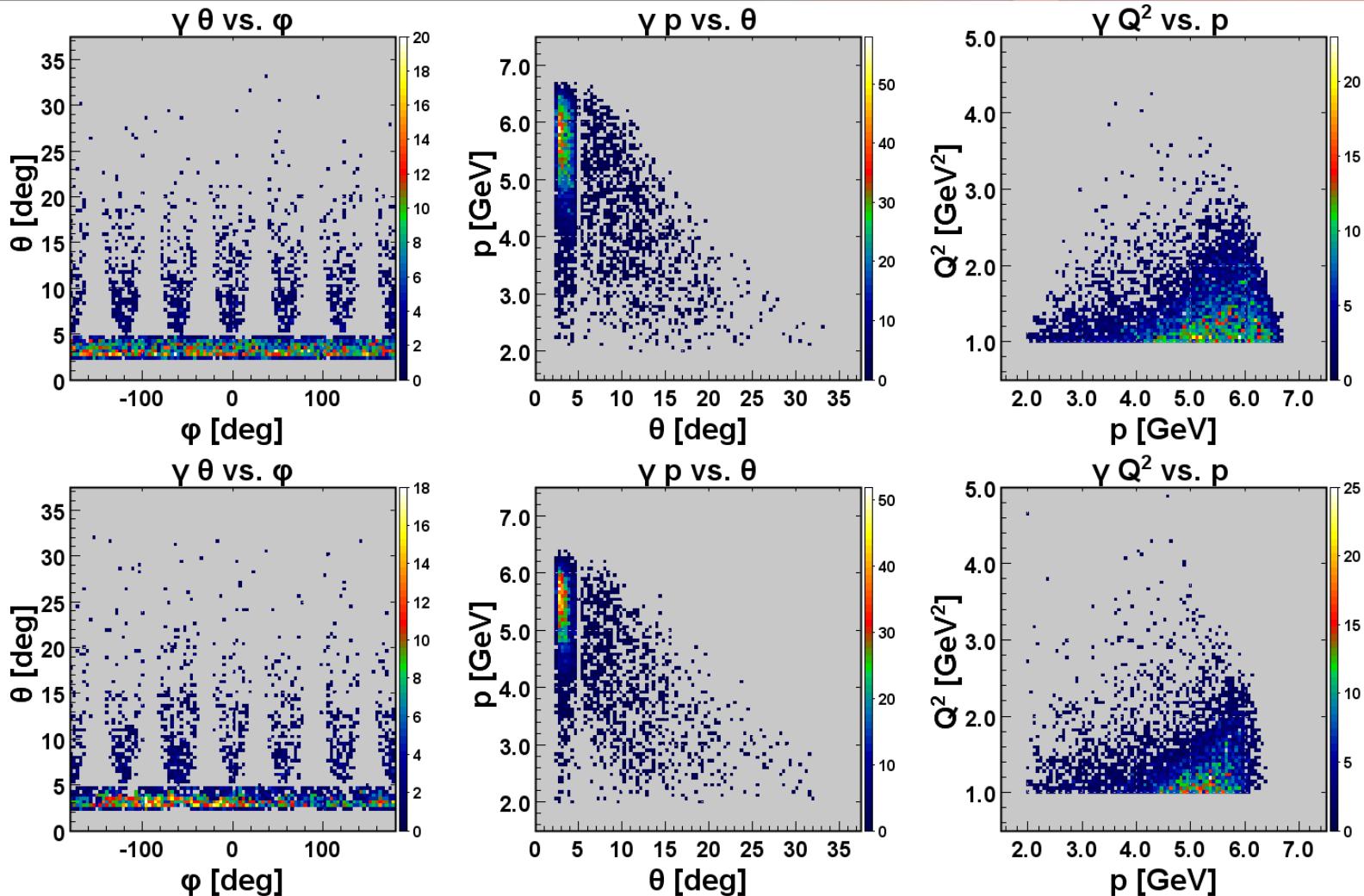
$Q^2 > 1 \text{ GeV}^2$, $W > 2 \text{ GeV}$, and $|q^\mu| > 2 \text{ GeV}$: Simulation (Top) and Data (Bottom)

DVCS $p\gamma$ Kinematics



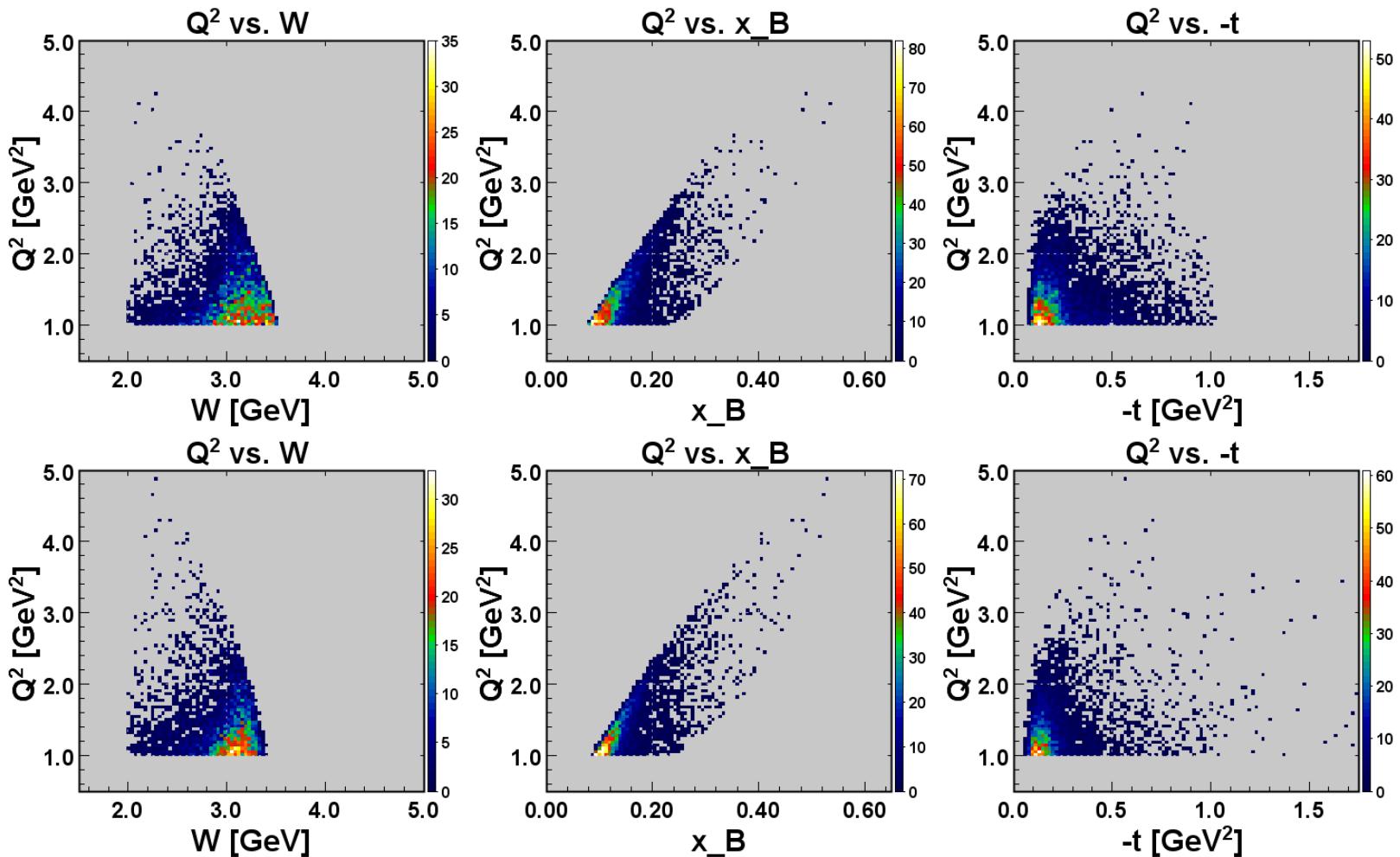
$Q^{12} > 1 \text{ GeV}^2$, $W > 2 \text{ GeV}$, and $|q\gamma| > 2 \text{ GeV}$: Simulation (Top) and Data (Bottom)

DVCS $\gamma\gamma'$ Kinematics



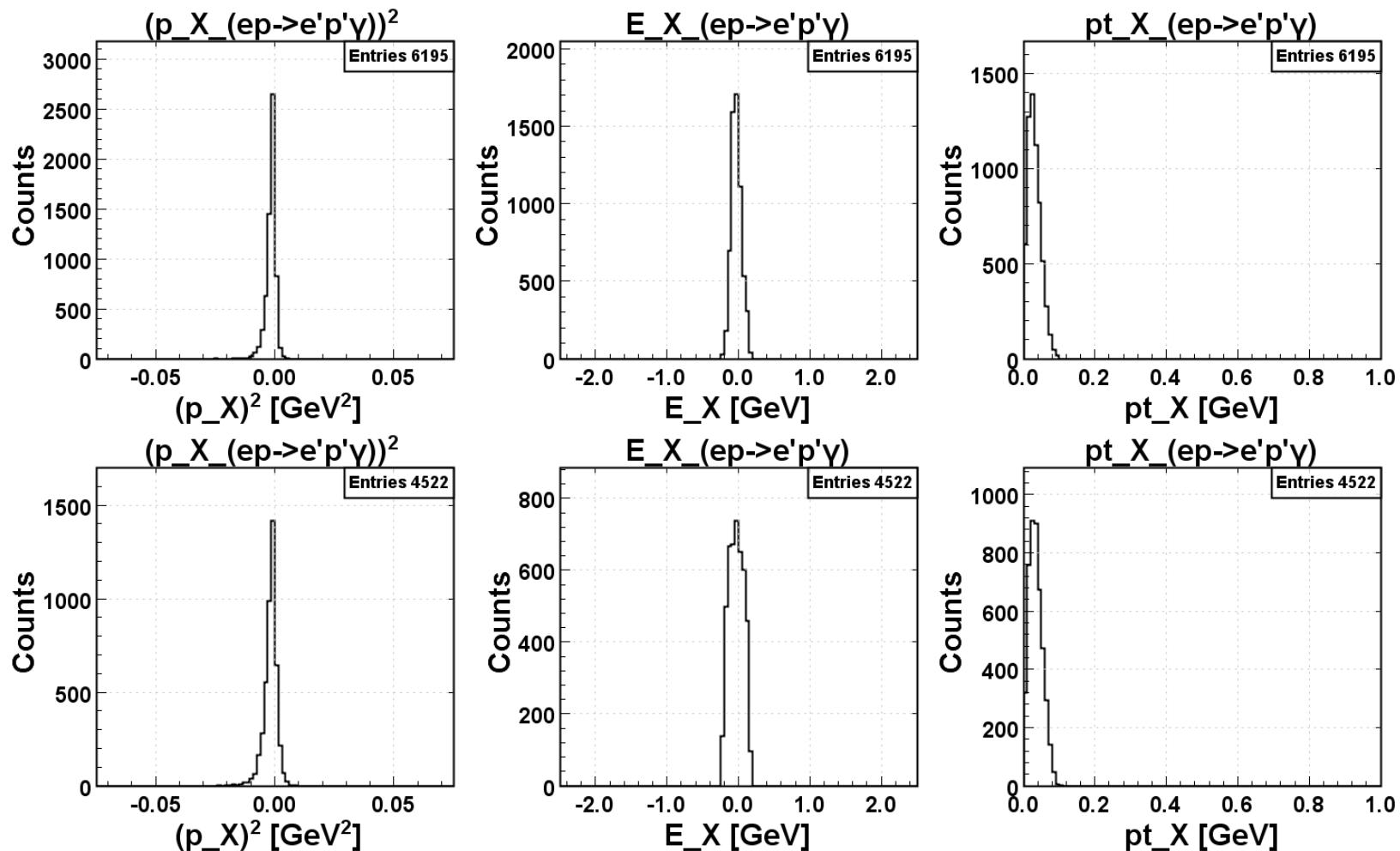
$Q^{12} > 1$ GeV 2 , $W > 2$ GeV, and $|q\gamma'| > 2$ GeV: Simulation (Top) and Data (Bottom)

DVCS Kinematic Variables



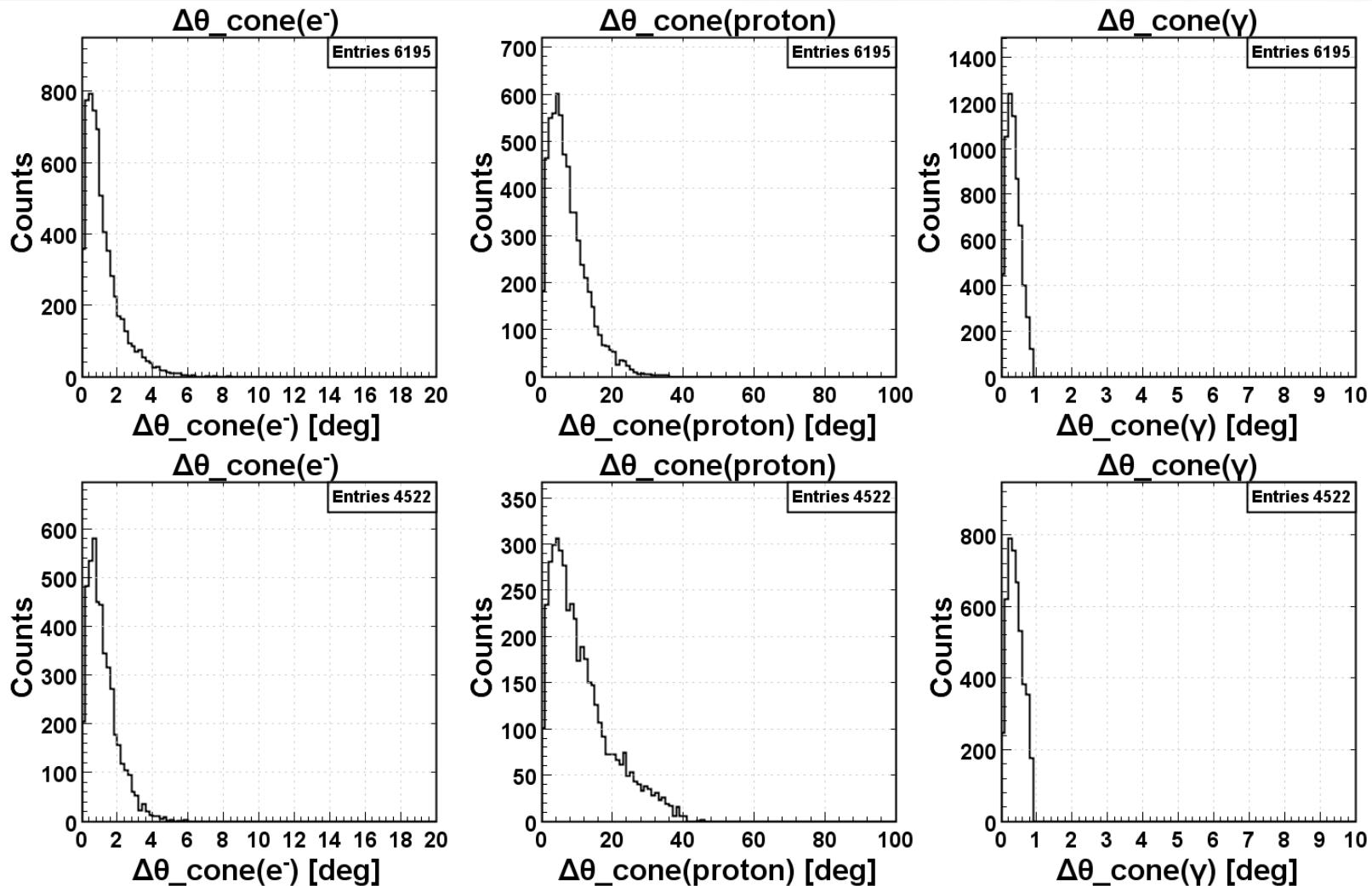
$Q^2 > 1 \text{ GeV}^2$, $W > 2 \text{ GeV}$, and $|q^T| > 2 \text{ GeV}$: Simulation (Top) and Data (Bottom)

DVCS $ep \rightarrow e\gamma' p\gamma \gamma X$



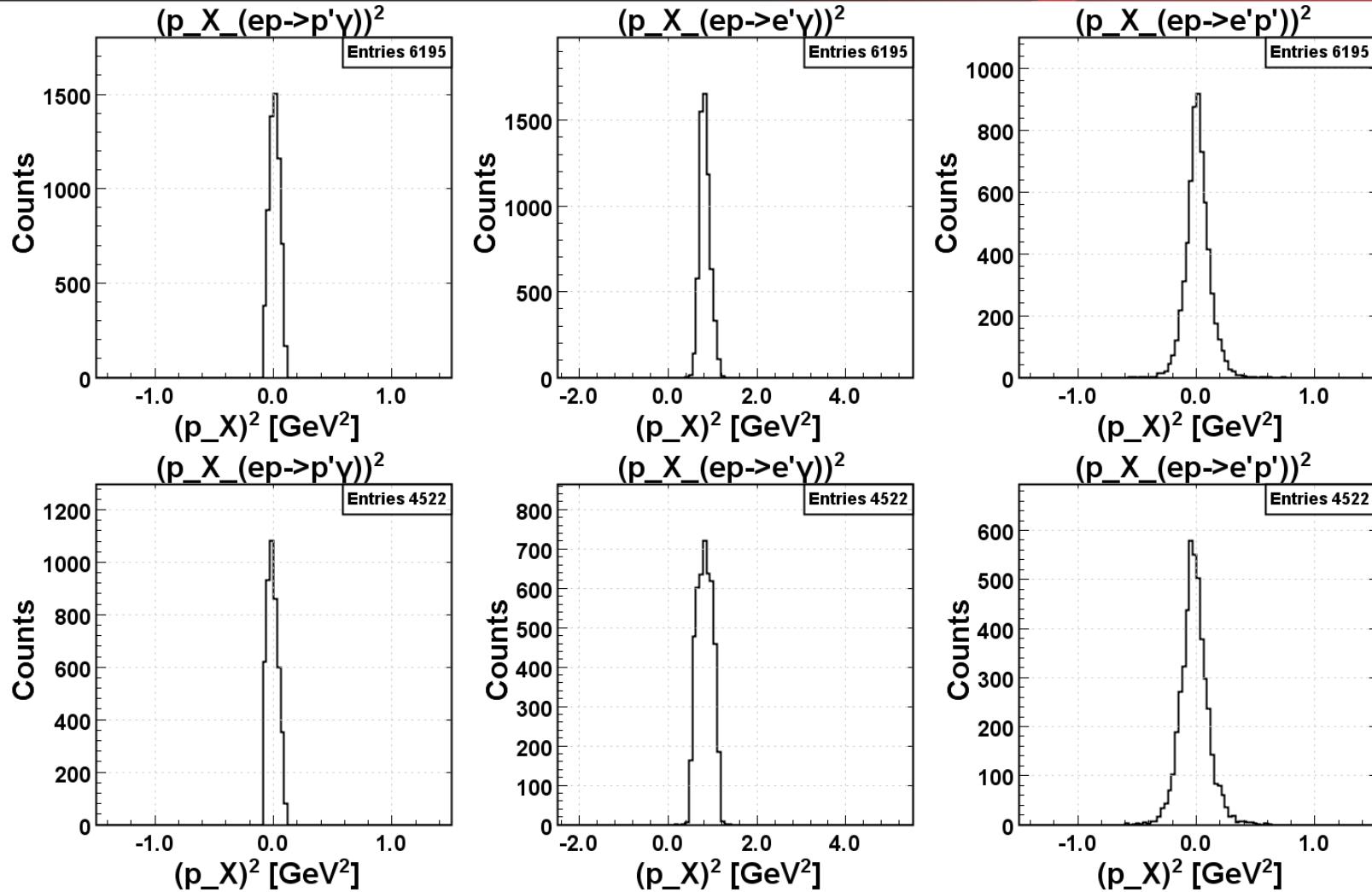
$Q^2 > 1 \text{ GeV}^2$, $W > 2 \text{ GeV}$, and $|q\gamma'| > 2 \text{ GeV}$: Simulation (Top) and Data (Bottom)

DVCS Cone Angles



$Q^2 > 1 \text{ GeV}^2$, $W > 2 \text{ GeV}$, and $|q^T| > 2 \text{ GeV}$: Simulation (Top) and Data (Bottom)

DVCS Missing Particles



$Q^2 > 1$ GeV 2 , $W > 2$ GeV, and $|q^T| > 2$ GeV: Simulation (Top) and Data (Bottom)

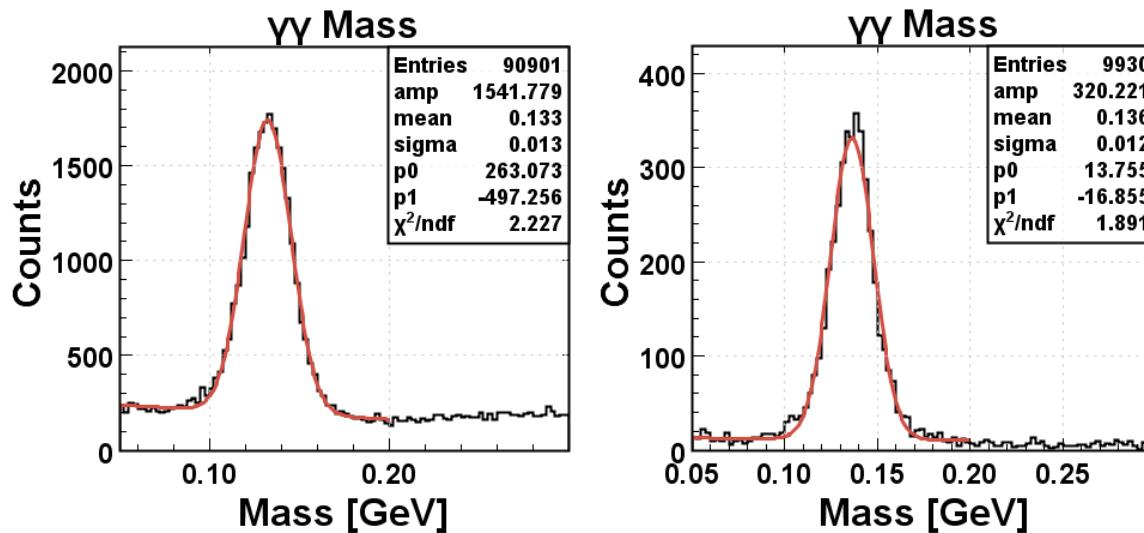
Summary and Future Plan/s

- Cleanup of DVCS events with $\Delta\theta \downarrow \text{cone}(\gamma)$, $E \downarrow X \downarrow e \uparrow p \uparrow \gamma$, and $p \uparrow \gamma$ missing mass-squared cut resulted to drop in DVCS events to 25.9% and suppression of DV $\pi \uparrow 0$ P contaminants to 1.8%.
- There is a good qualitative agreement between data and simulation after the cleanup.
- Other strategies will be considered and tried for DVCS and DV $\pi \uparrow 0$ P separation.

Thank You!!!

γ Recovery

$E\downarrow dep1 > 0.25$ and $E\downarrow dep2 > 0.25$
 $E\downarrow dep1 > 0.1$ and $E\downarrow dep2 > 0.1$ $\gamma\downarrow 1 \gamma\downarrow 2 > 1^\circ$



With an identified coincident $p\gamma'$ any neutral particle can be assumed as γ . Using the sampling fraction $SF=0.25(1.029-0.015/E\downarrow dep + 0.00012/E\downarrow dep \gamma 2)$, γ momentum E can be calculated from the total energy deposited in ECal $E\downarrow dep$ as follows: $E=E\downarrow dep/SF$.