4.2M-event Study for Exclusive+Diffractive

Response to PWG conveners' requests

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Context from Conveners (Salvatore's email)

- Show more about reconstructed proton distributions and relevant variables.
- Produce 10x fewer events and re-scale uncertainties (fast study).
- Minimum Q^2 cut: why not $Q^2 > 1$ GeV² instead of 5?
- (Analysis nice-to-have) Compare FPS tagging with rapidity-gap method.

Timeline: Internal review Tue Sep 2, 16:00; PWG update Mon Sep 8.

Dataset and Selection

- 4.2M events processed with FPS acceptance.
- DIS kinematics reconstructed: x, Q^2 , y.
- Proton tagged in FPS; multiple t-reconstruction methods (now we have BABE, can add maybe another).

Reco-level plots already available

- Proton spectrometer: p_p, θ_p, ϕ_p , momentum loss ξ .
- t-spectrum: direct FPS, BABE, lepton-only, mixed methods.
- Correlation reco plots vs truth.
- DIS kinematics x, Q^2 , y with different reconstructions.
- Cross sections $d\sigma/dx$, $d\sigma/dQ^2$, $d\sigma/dy$, $d\sigma/d|t|$.
- Resolution and pulls for t, x, Q^2 , y.

FPS proton kinematics

figs/pp_theta.pdf	figs/pp_phi.pdf
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Momentum transfer t (methods)

Definitions

$$tpprox (p_p-p_p^{\mathsf{beam}})^2\simeq -(\Delta p_T)^2-rac{(\Delta E)^2}{eta^2}$$

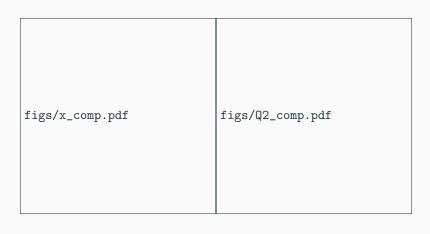
- FPS-direct (track based)
- BABE method (using 4-momenta)

t spectrum @ reco (FPS-direct) figs/t_hist.png

t reconstruction: BABE vs truth



DIS kinematics @ reco



Cross sections (single differentials)



Fast statistical scaling study

Uncertainty scaling

$$\delta\sigma\propto\frac{1}{\sqrt{N}}$$

If $N \to N/10$, then

$$\delta\sigma_{N/10} \approx \sqrt{10}\,\delta\sigma_{N}.$$

Why
$$Q_{min}^2 = 1 \text{ GeV}^2$$
?

- Extends reach to lower x, diffractive-enhanced phase space.
- Potentially more statistics, but more sensitive to systematics.
- ullet Plan: compare $Q^2>1~{
 m vs}>5~{
 m GeV}^2$ in control plots.

Next steps

- Tue Sep 2, 16:00: internal review with Hadi.
- Mon Sep 8: PWG update with full reco-proton plots and scaling.
- Optional: generate high- Q^2 subsample if needed.



Extra method comparisons, resolution plots, alternative binning.