DVCS on ep

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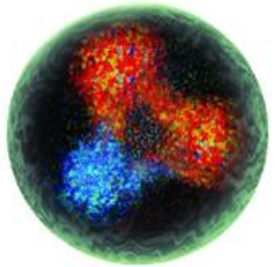
Nucleon Tomography

- Want to investigate the internal structure of nucleons.
  - **Parton distributions**
- Most general description: Wigner Function
  - Gives full phase space distribution.
- Integrate w.r.t transverse momentum:
  - **Generalised Parton Distributions (GPDs)**
  - Relates the transverse position (b_T) of partons to their longitudinal momentum (x) in the infinite momentum frame.
- DVCS can access *linear combinations* of 4 GPDs: H_q, E_q, $\widetilde{H}_q$, $\widetilde{E}_q(x, \xi, t)$
- These can be related to PDFs and form factors.

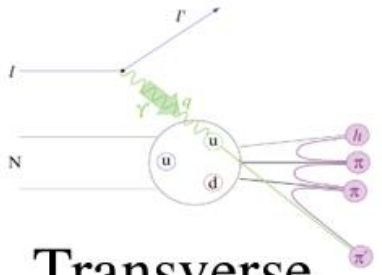
Images of the nucleon



Wigner function: full phase space parton distribution of the nucleon

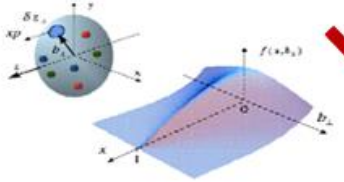
$\int d^2k_T$

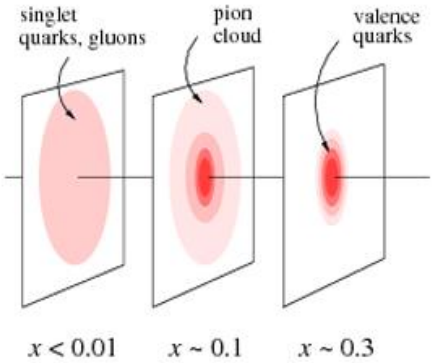
$\int d^2b_T$



Transverse Momentum Distributions (TMDs)

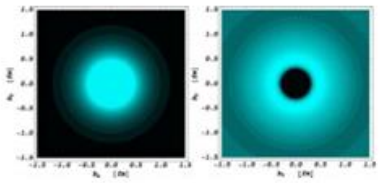
Generalised Parton Distributions (GPDs)





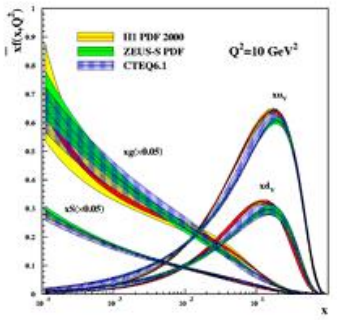
$\int dx$

Form Factors *eg*: G_E, G_M



$\int d^2k_T$

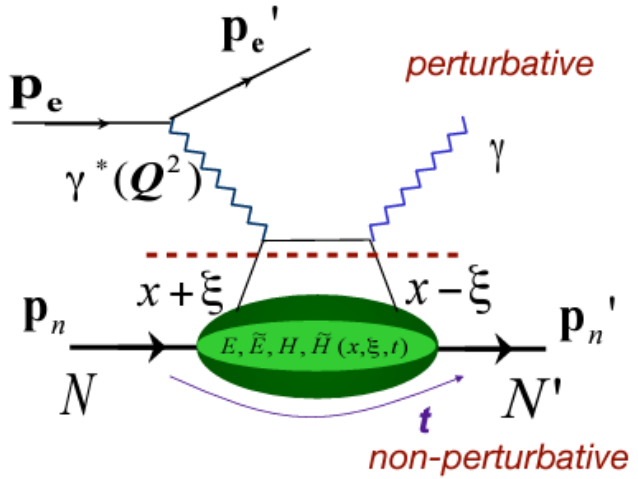
Parton Distribution Functions (PDFs)



From a talk by D. Sokhan

GPDs and DVCS

✱**Deeply Virtual Compton Scattering:** golden channel for the extraction of GPDs.



$$Q^2 = -(\mathbf{p}_e - \mathbf{p}_e')^2 \qquad t = (\mathbf{p_n} - \mathbf{p_n}')^2$$

Bjorken variable: $x_B = \dfrac{Q^2}{2\mathbf{p_n}\cdot\mathbf{q}}$

$x \pm \xi$ *longitudinal momentum fractions of the struck parton*

$$\xi \cong \frac{x_B}{2 - x_B}$$

✱ At high exchanged Q^2 and low t access to four chiral-even GPDs:

$$E^q, \tilde{E}^q, H^q, \tilde{H}^q(x,\xi,t)$$

✱ Can be related to PDFs:

$$H(x,0,0) = q(x) \qquad \tilde{H}(x,0,0) = \Delta q(x)$$

and form factors:

$$\int_{-1}^{+1} H dx = F_1 \qquad \int_{-1}^{+1} \tilde{H}\, dx = G_A$$

$$\int_{-1}^{+1} E\, dx = F_2 \qquad \int_{-1}^{+1} \tilde{E}\, dx = G_P$$

✱Small changes in nucleon transverse momentum allows mapping of transverse structure at large distances.

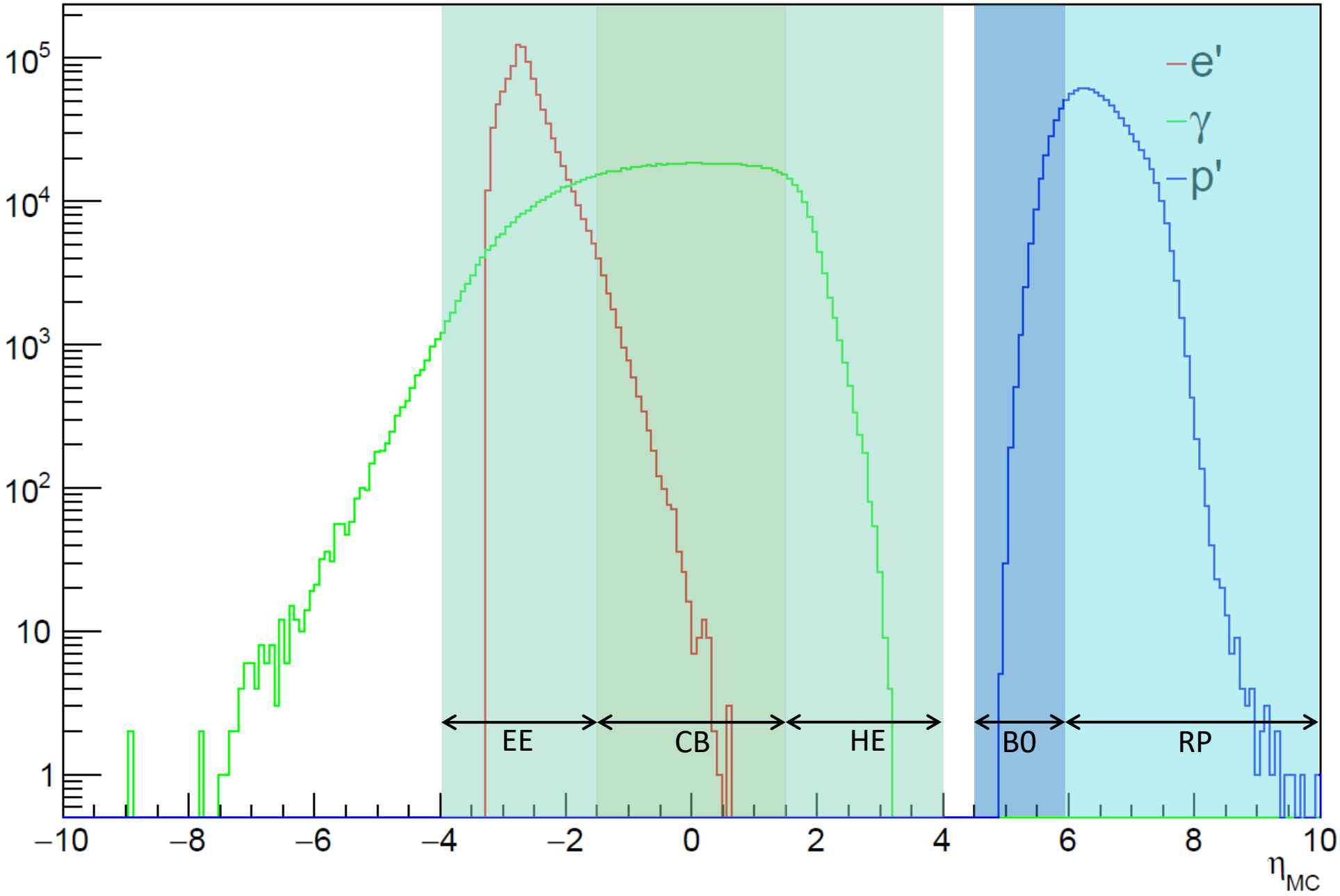
From a talk by D. Sokhan

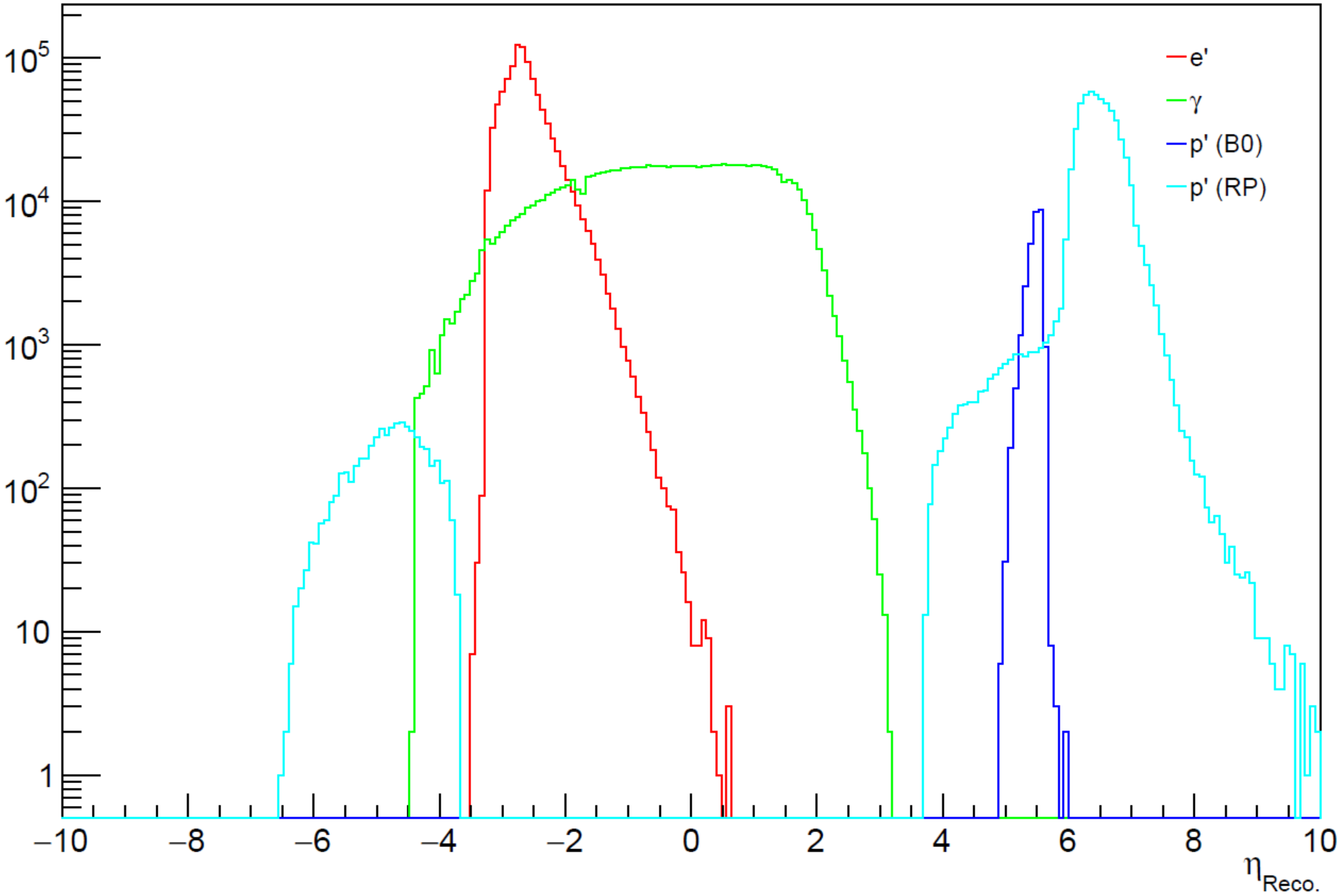
DVCS in ePIC: Simulations

- Using simulated ep collisions made using the EpIC MC generator.
- Passed through full software stack in simulation campaigns.
  - Full set of beam energies: 5x41, 10x100, 18x275 GeV.
  - Both for high divergence and high acceptance beam settings.
- Interesting for most regions of the ePIC detector.
  - Central barrel/backward endcap for electron ID.
  - Barrel and both endcaps for photon ID.
  - Far forward region (B0 and RP) for detection of scattered proton.
- Study began as a test of B0 resolution.

Afterburned MC

10x100, high acceptance setting



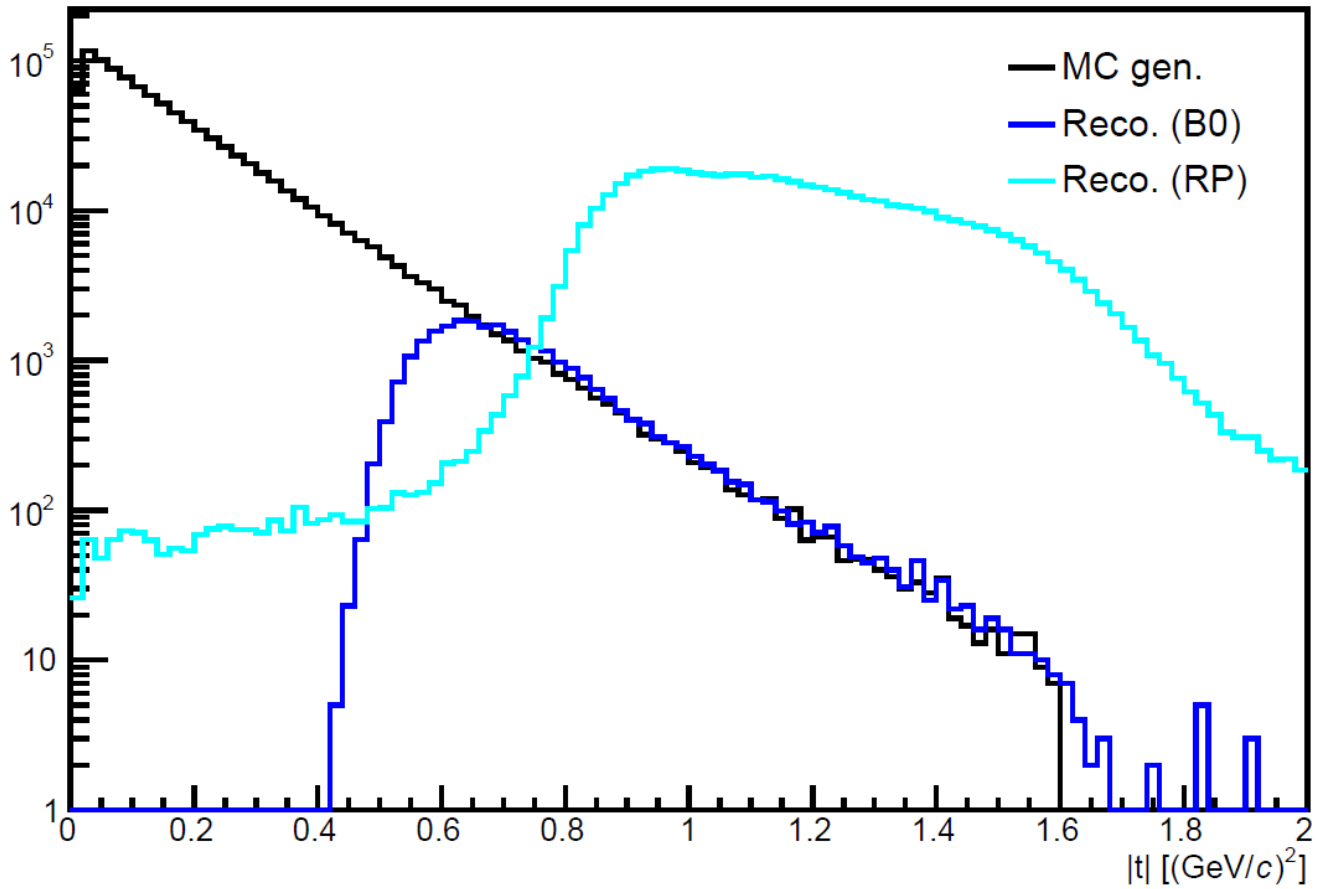


Clear issue present with reconstruction of Roman Pots.

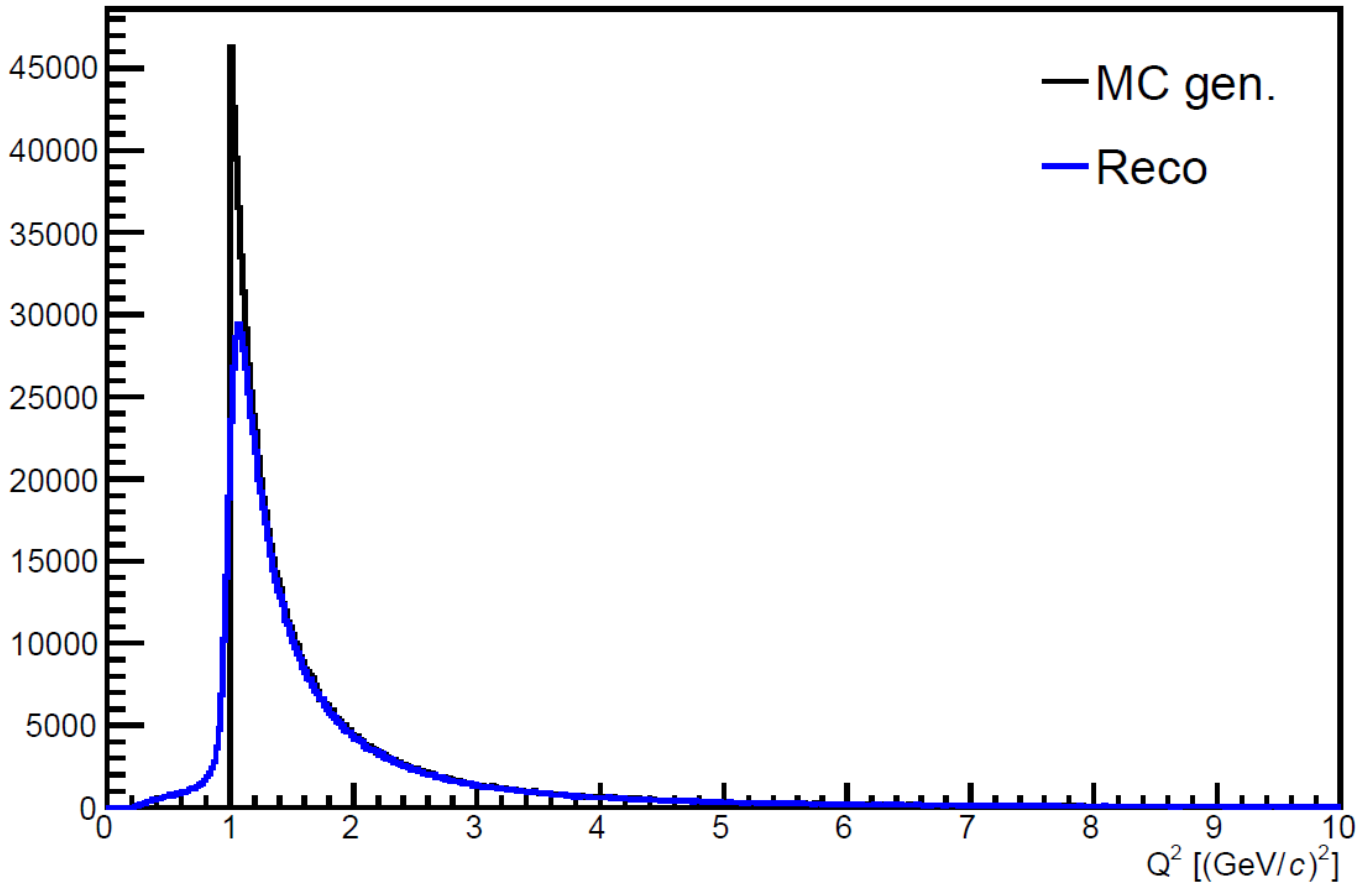
Known about: default campaign reconstruction uses RP settings for 18x275 GeV beam energy.

For anything else, events need to be reconstructed offline.

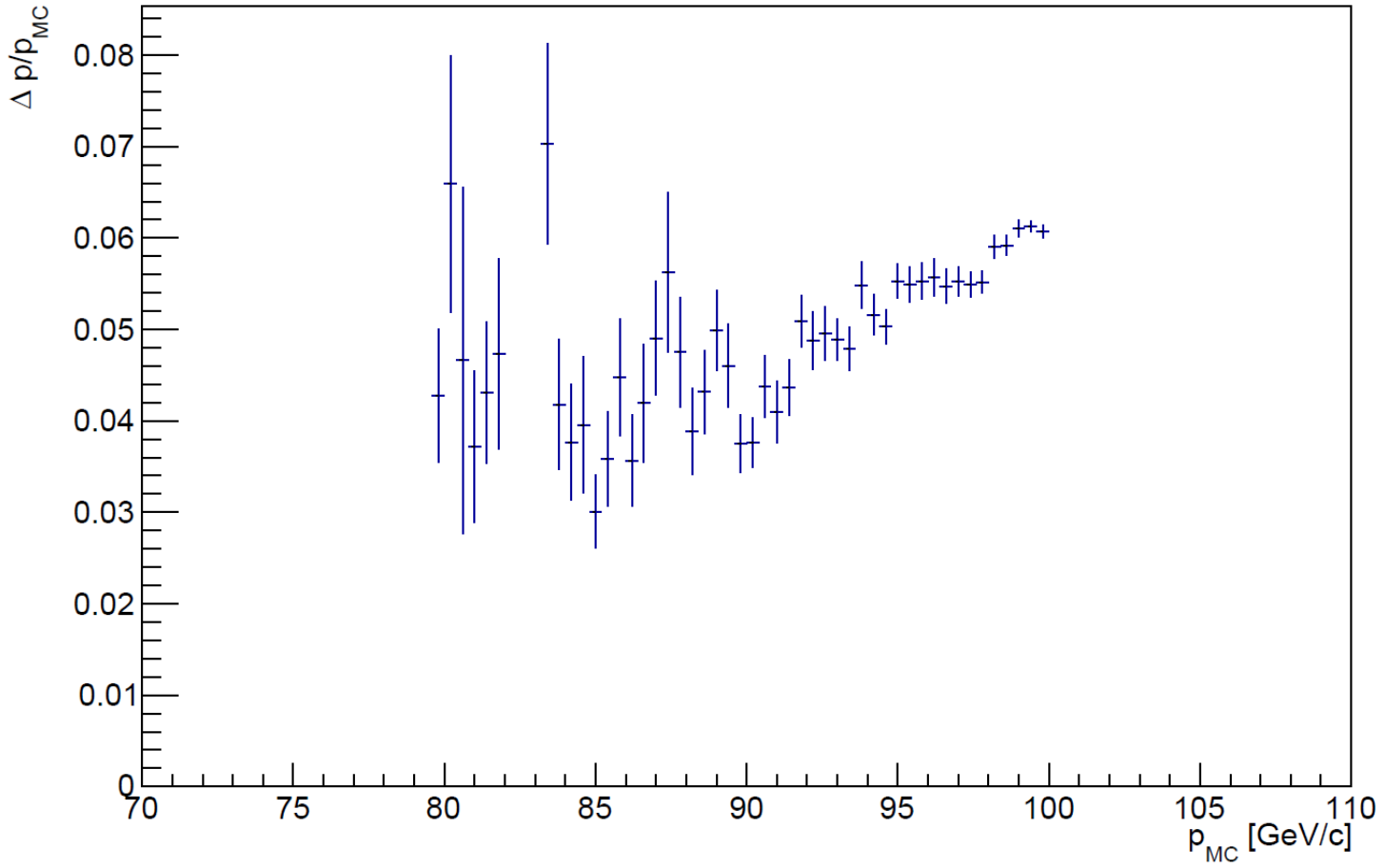
Reconstruction of event kinematics: t



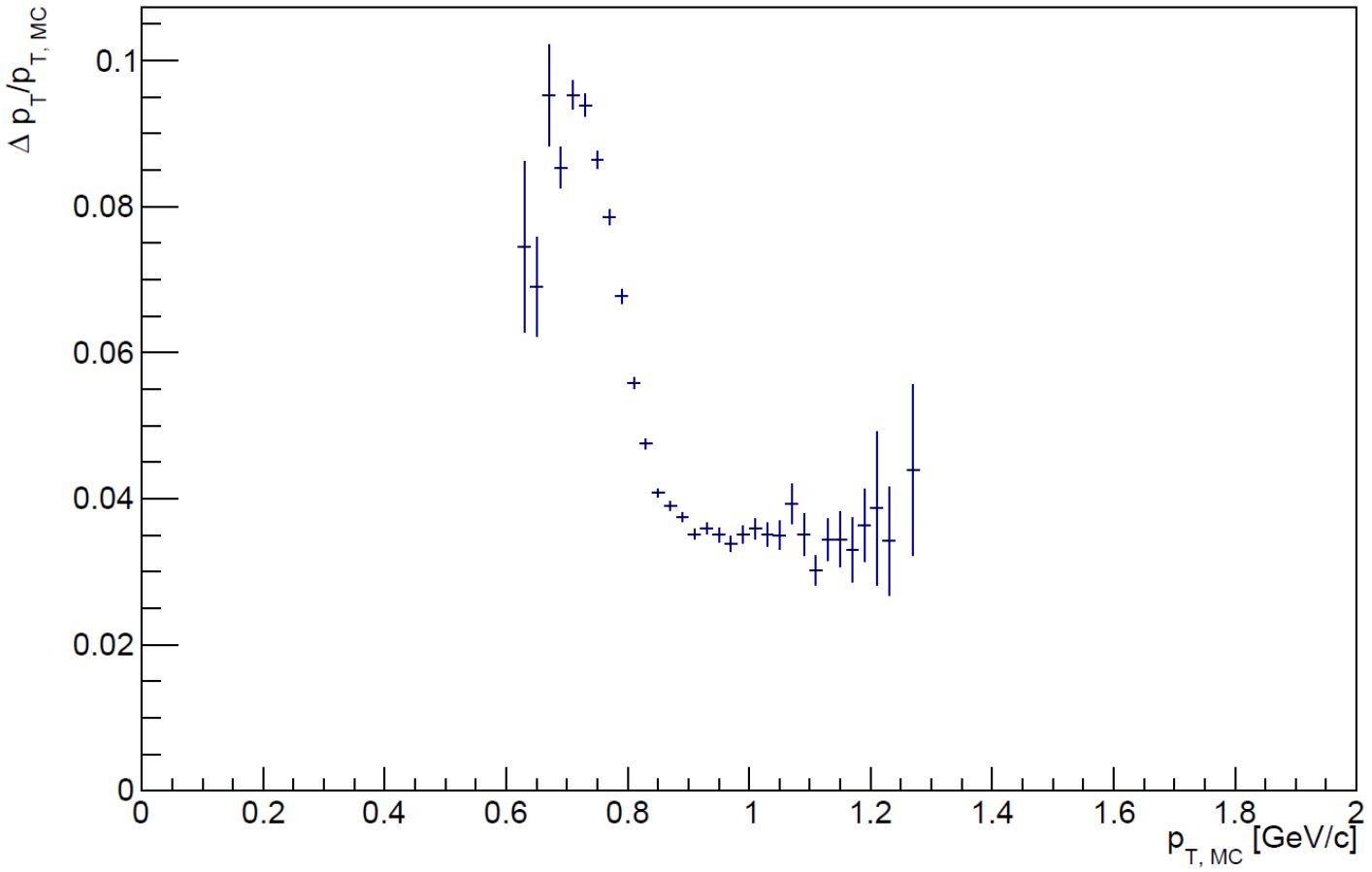
Reconstruction of event kinematics: Q^2



B0 resolution: 3-momentum



B0 resolution: transverse momentum



Ongoing work

- Need to run this analysis with each new simulation campaign.
  - Keep an eye on the B0 resolution with each change to detector and beamline configuration.
- Suggestion made that current t calculation is overconstraining – need to compare calculations.
- Looking at particles in the rapidity gap between Barrel ECAL and EE ECAL.