B0 neutrons reconstruction at the EIC

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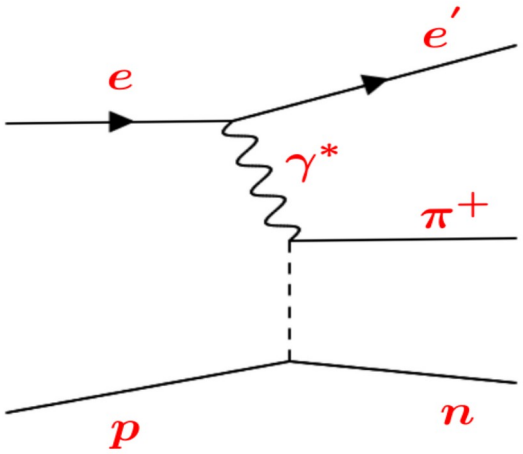
ePIC simulations for exclusive reactions

- Feasibility studies of exclusive pion electroproduction reaction through ePIC simulations.
- For π^+ electroproduction reaction:

$$e + p \rightarrow e' + \pi^+ + n$$

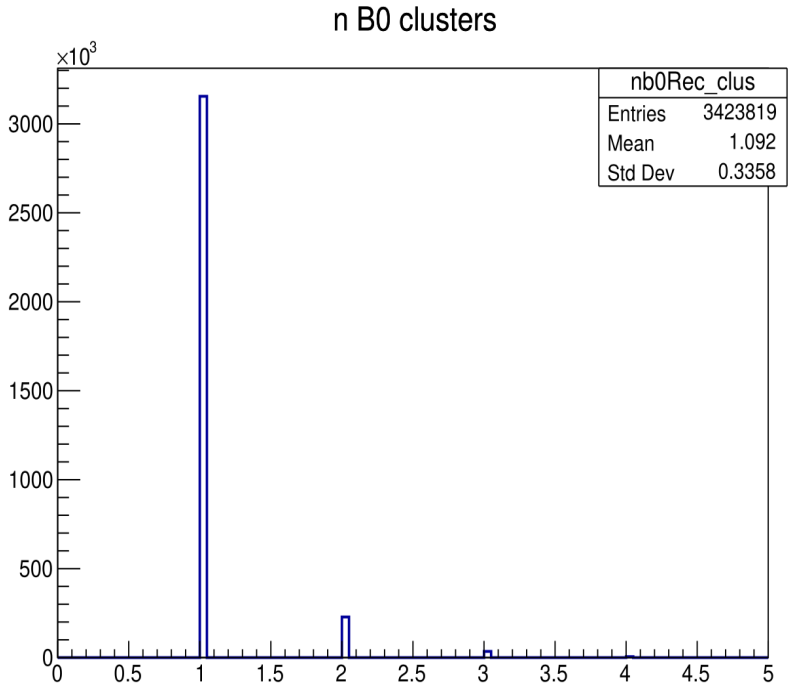
  - Indirectly use the "pion cloud" of the proton via the p(e,e' π^+ n) process.

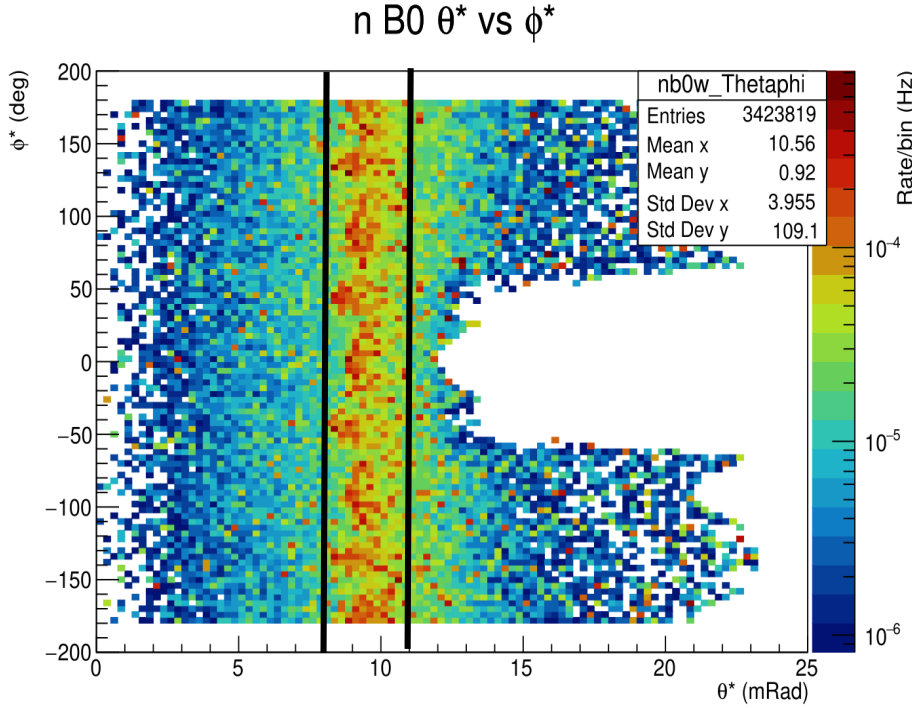


- Identification involves reconstructing all final state particles.
- Reconstruct e'/π^+ tracks from the central detector.
- Track neutrons in the ZDC – HCAL & B0 – EMCAL (for the first time).
  - Reconstructed neutrons from ZDC – HCAL allow access to small -t.
  - B0 – EMCAL enables achieving higher values of -t.

B0 clusters & θ^*, * distributions

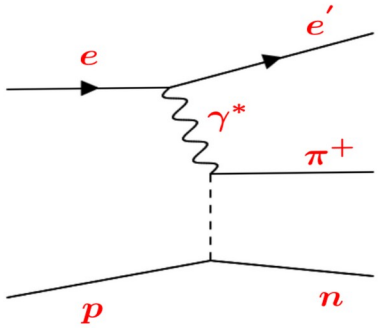
- Considered clusters = 1 & $8.0 < \theta^*$ (mRad) < 11.0 events.





B0 $-t_{truth}$ vs $-t_{rec\_corr}$ distribution

$$-t_{truth} = -(\gamma^* - \pi^+)^2$$

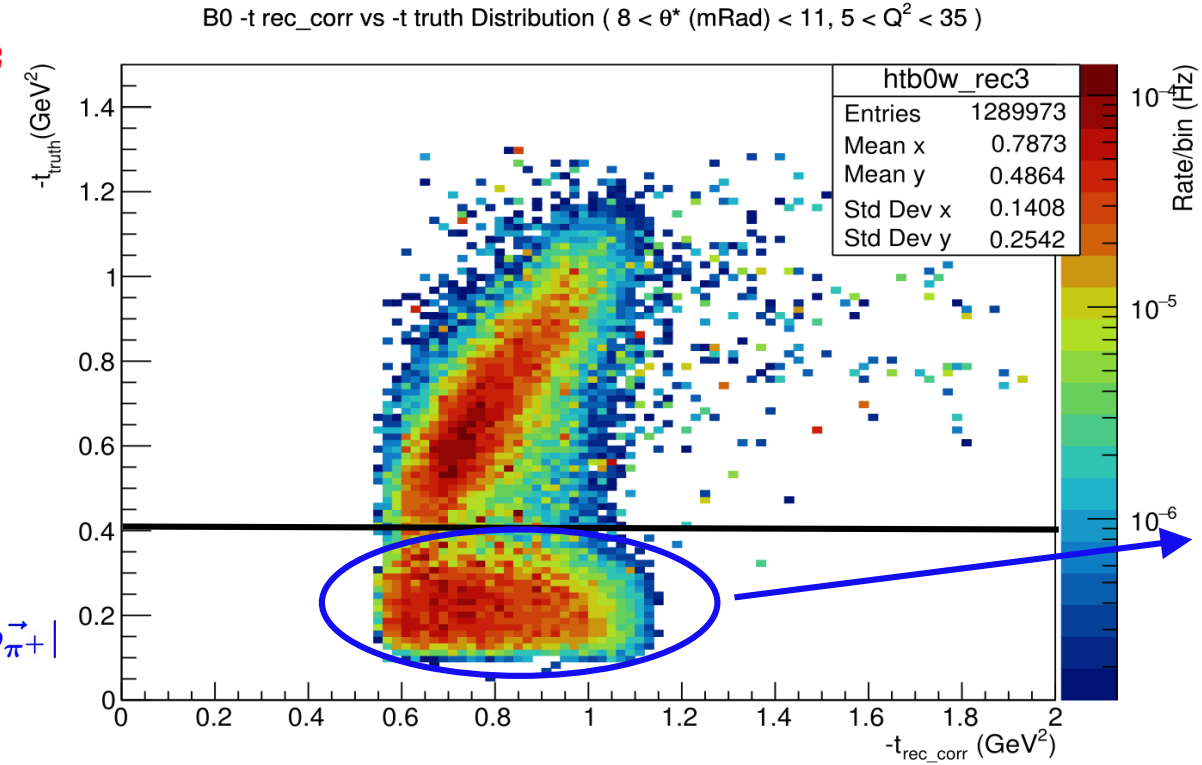


Reconstructed n_corr:

Using missing momentum information,

$$p_{miss} = |\vec{p_e} + \vec{p_p} - \vec{p_{e'}} - \vec{p_{\pi^+}}|$$

And replaced θ_{Miss} , ϕ_{Miss} with θ_{B0} , ϕ_{B0}, and fixed the neutron mass.

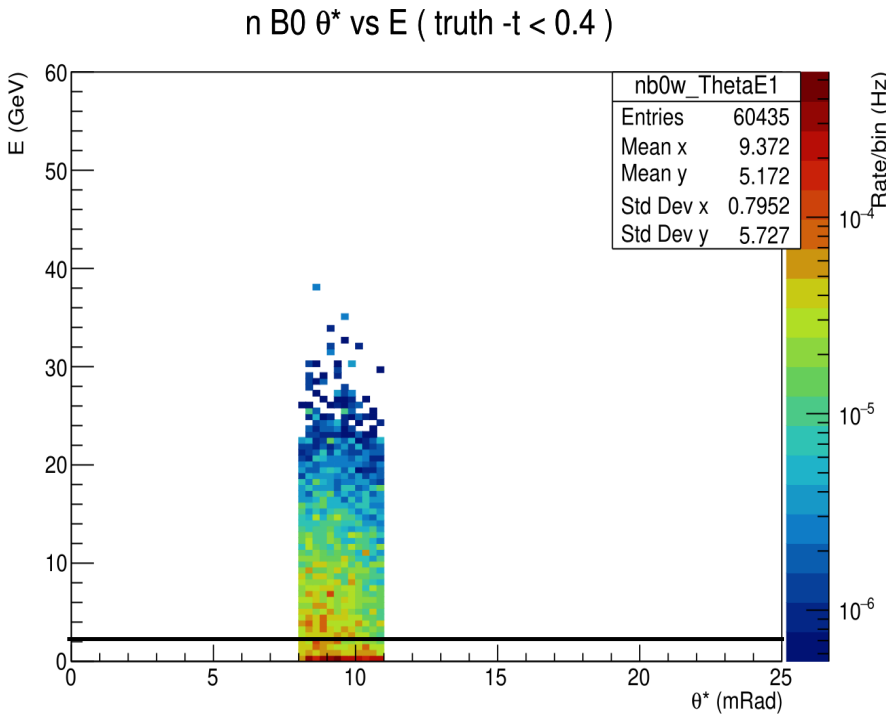


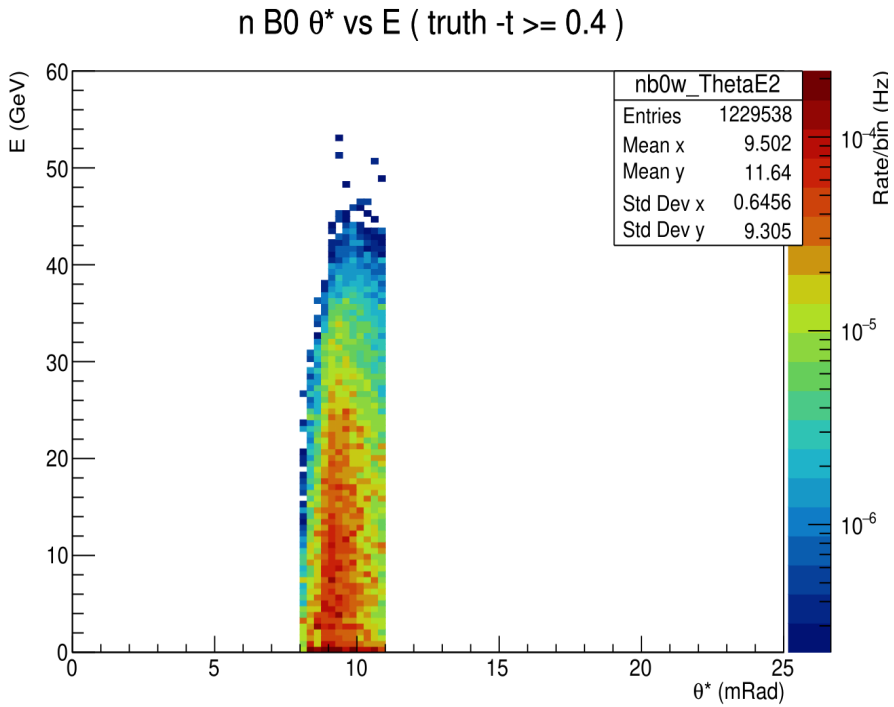
Background at higher rates.

$$-t_{rec\_corr} = -(p - n_{corr})^2$$

B0 energy distribution for two blobs

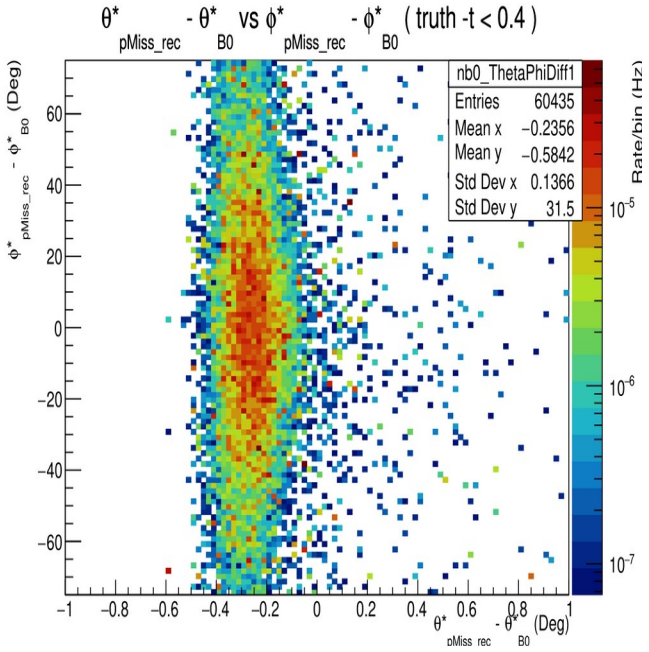
- Considered E > 2.0 events.

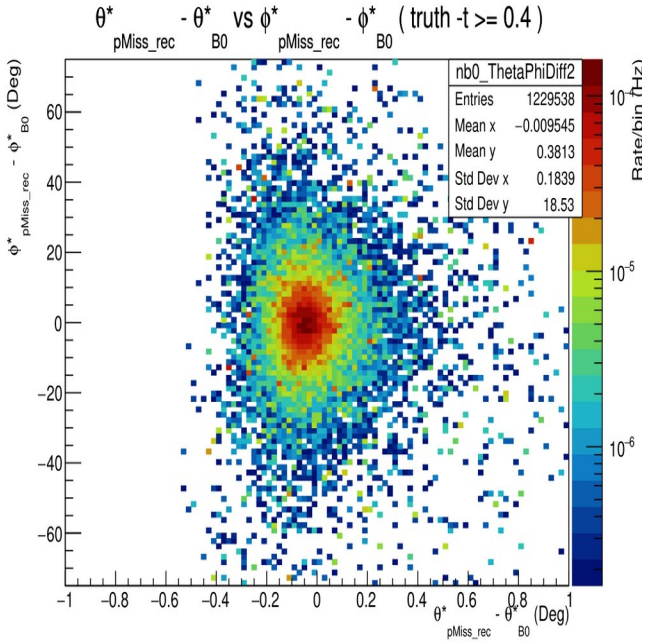


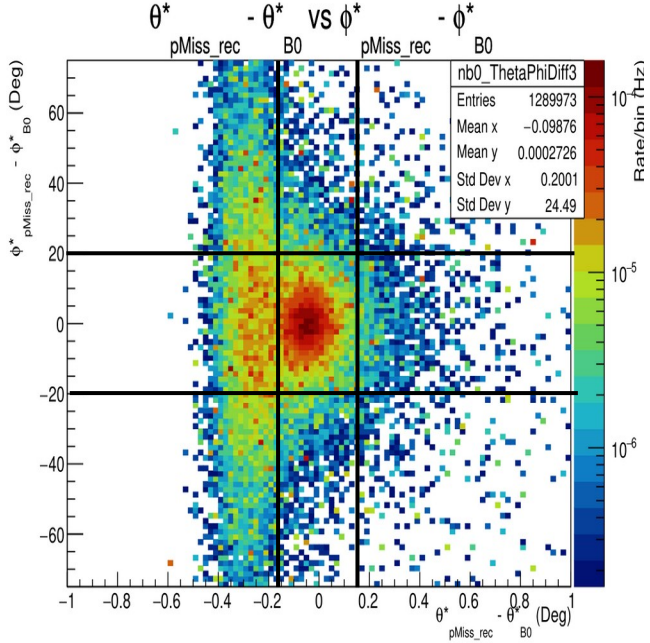


B0 $\Delta\theta$, Δ distribution for two blobs

- Considered - 0.15 < $\Delta\theta$ < 0.15 & - 20 < $\Delta\phi$ < 20 events.



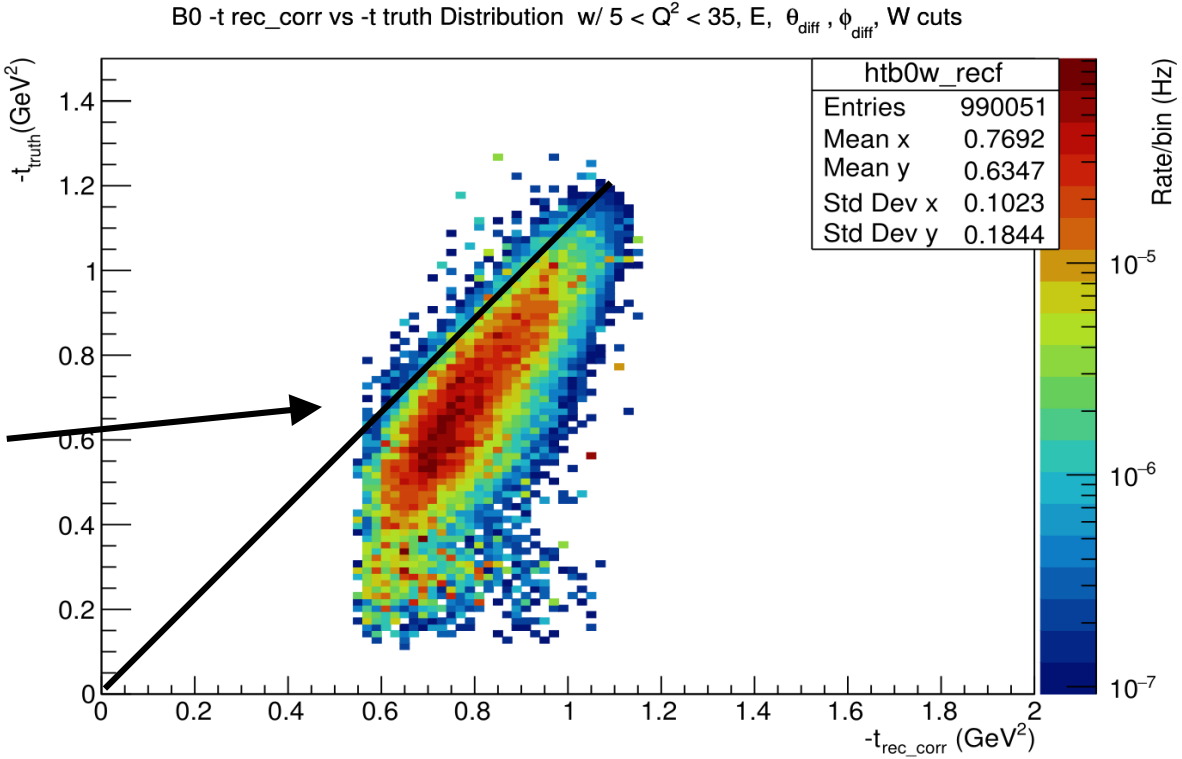




B0 $-t_{truth}$ vs $-t_{rec\_corr}$ distribution

- Cuts: -t, E, $\Delta\theta$, $\Delta\phi$, W & $-t_{truth}$ = no afterburner

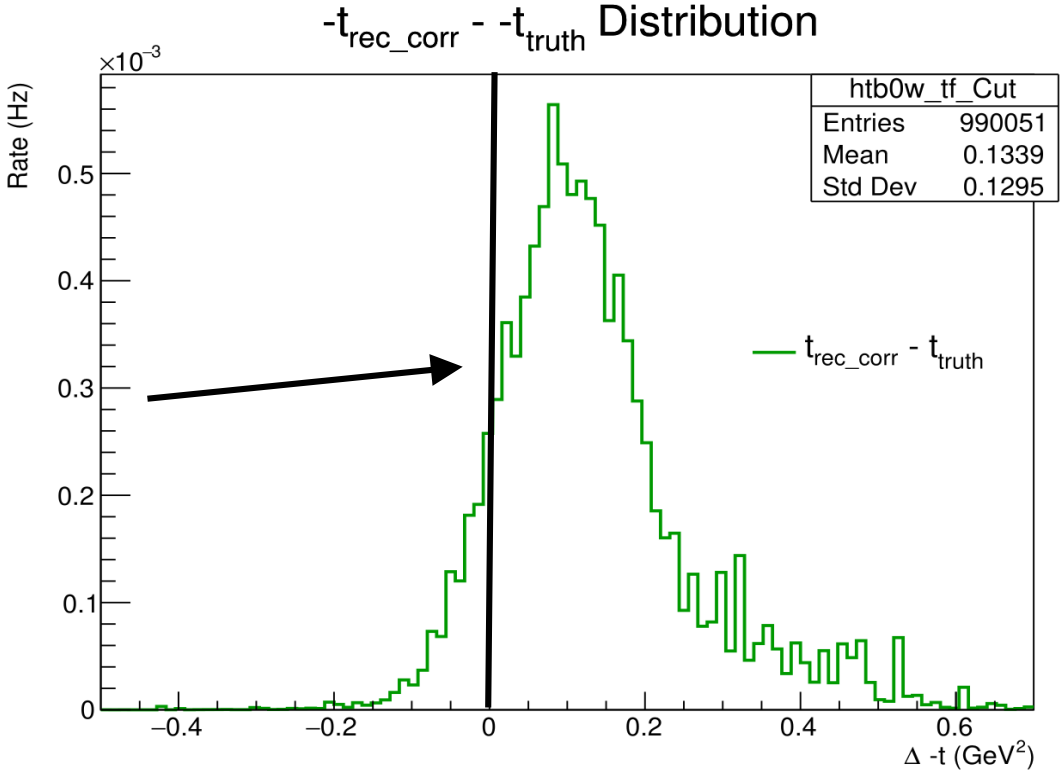
Intercept is not at zero.



B0 $-t_{truth}$ vs $-t_{rec\_corr}$ distribution

- Cuts: -t, E, $\Delta\theta$, $\Delta\phi$, W & $-t_{truth}$ = no afterburner

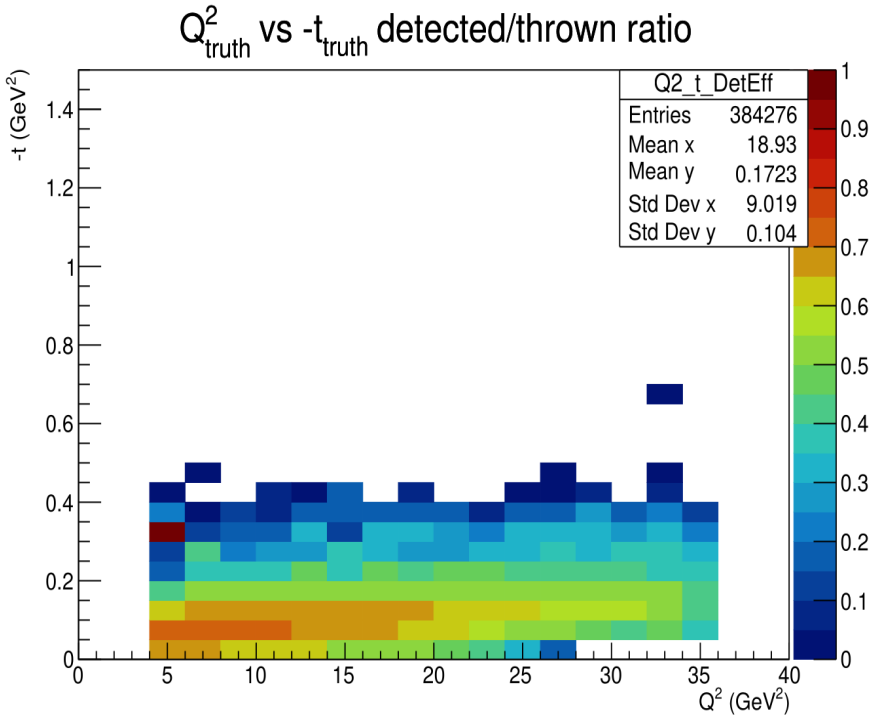
Not centred at zero.



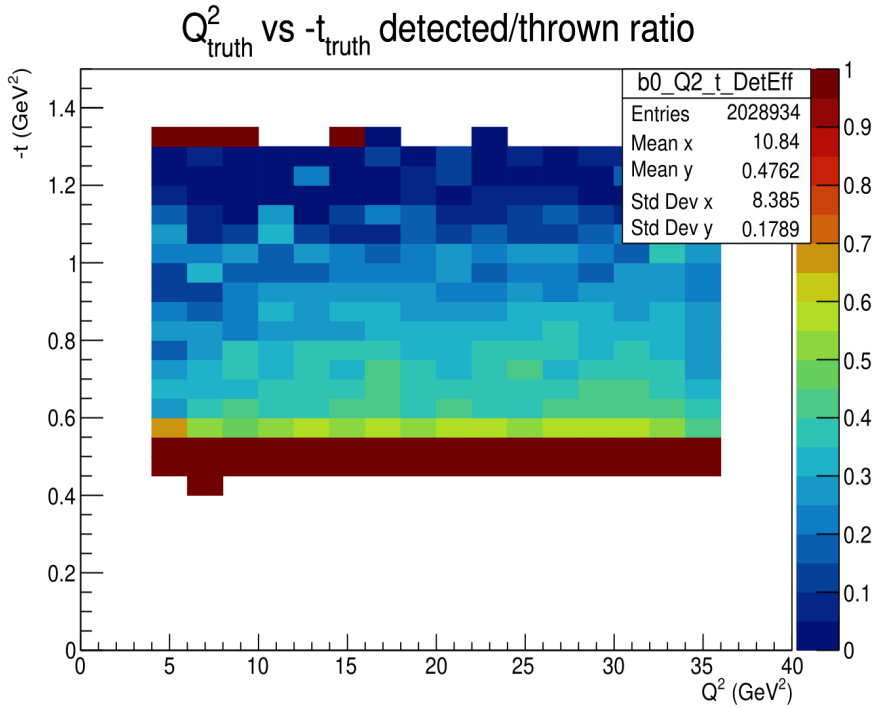
Detection efficiency per (Q^2, t) bin

- Cuts: -t, E, $\Delta\theta$, $\Delta\phi$, W & $-t_{truth}$ = no afterburner

ZDC



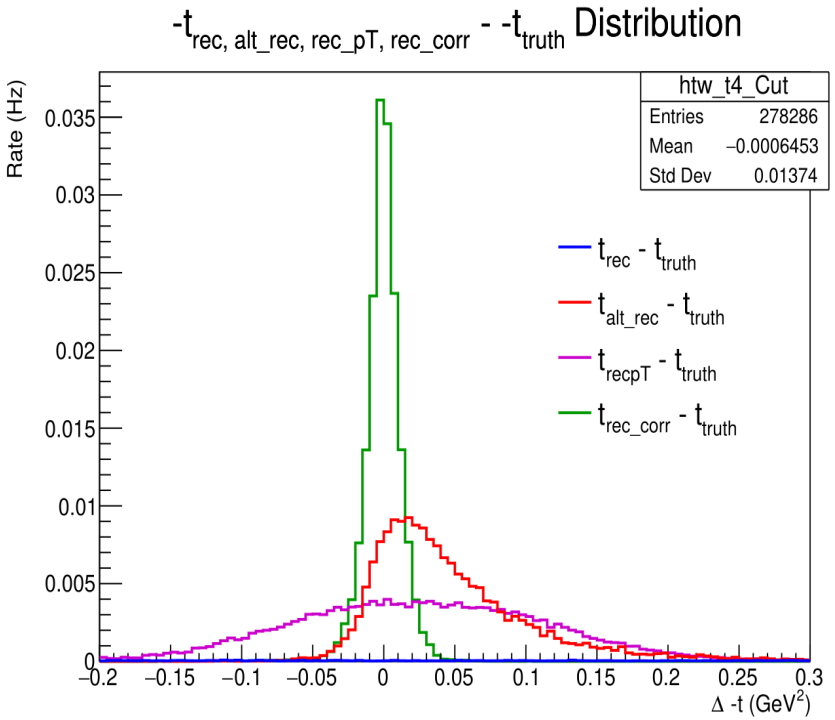
B0



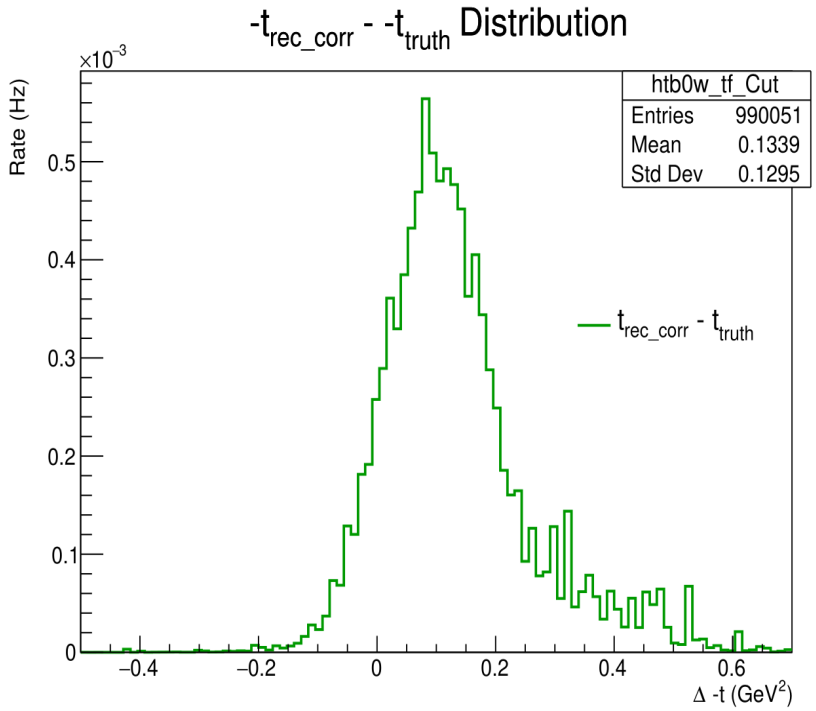
-t distributions from different methods

- Cuts: -t, E, $\Delta\theta$, $\Delta\phi$, W & $-t_{truth}$ = no afterburner

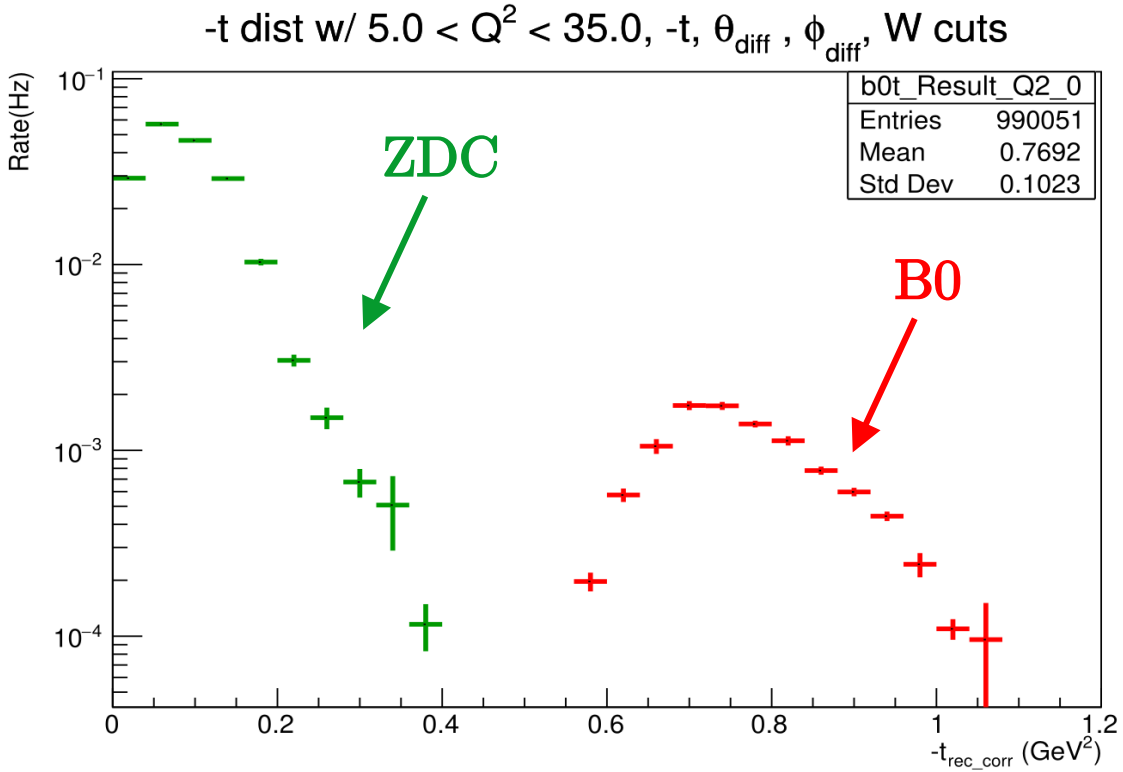
ZDC



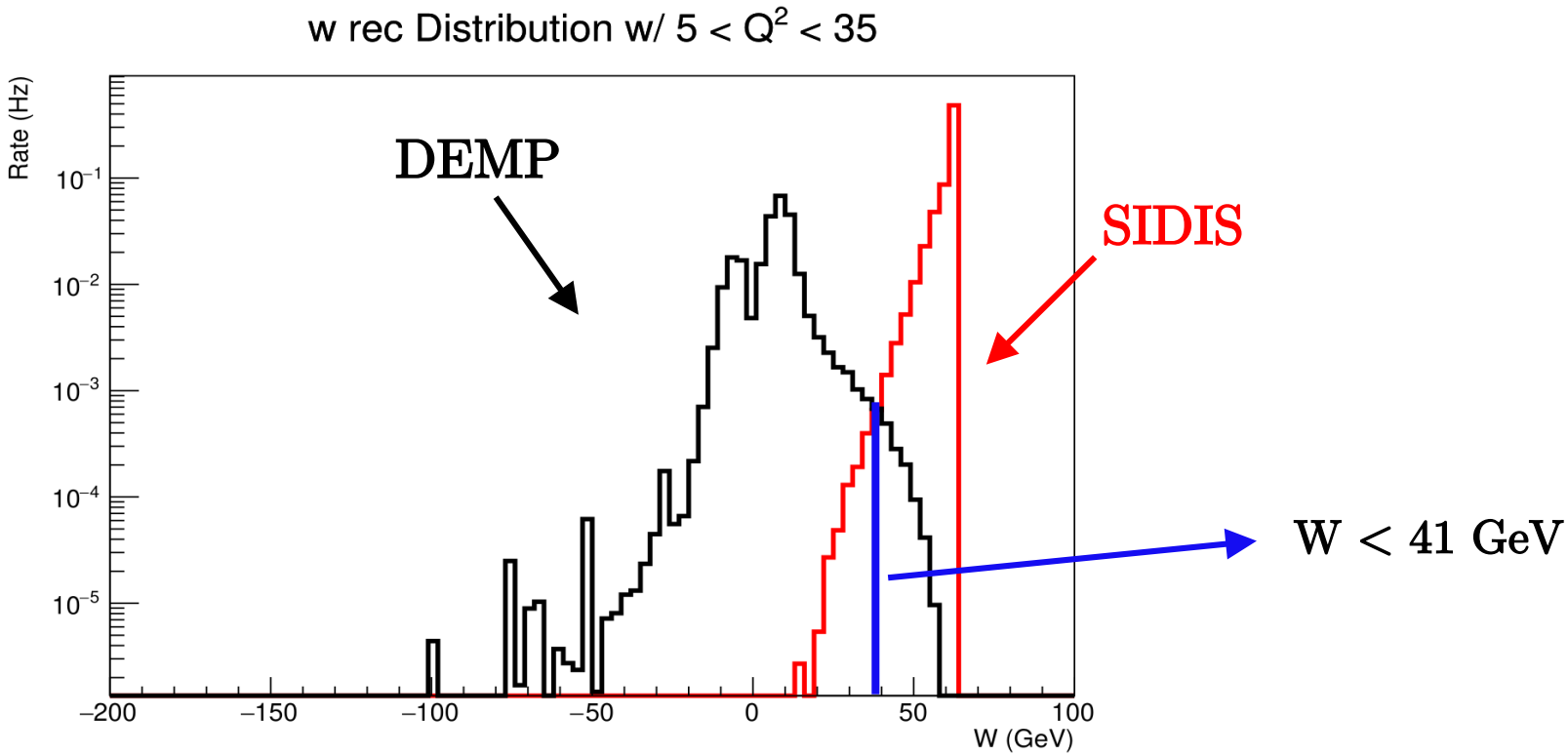
B0



-t distribution over wide Q^2 range



Removed SIDIS background with W cut



Summary

- Results so far look promising, and included the physics analysis plots in the pre(TDR) for the 10on100 beam energy combination using B0 & ZDC information.
- Accessing -t distribution over a wide range by combining information from both detectors.
- B0 $-t_{truth}$ vs $-t_{rec\_corr}$ distribution intercept is not at zero.
- B0 $-t_{truth}$ - $-t_{rec\_corr}$ distribution is not centred at zero.

Thank you !

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