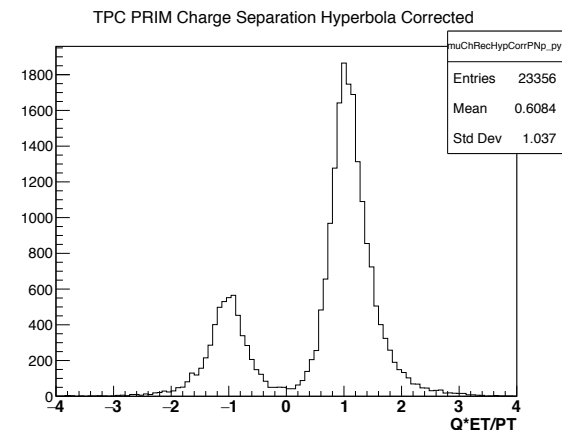# $W^+/W^-$ ratio analysis Run 17
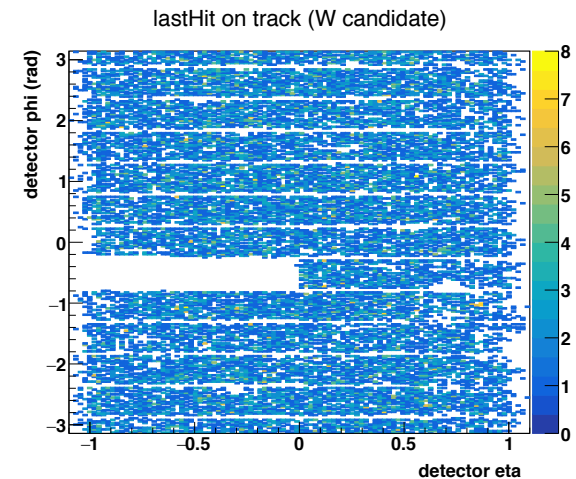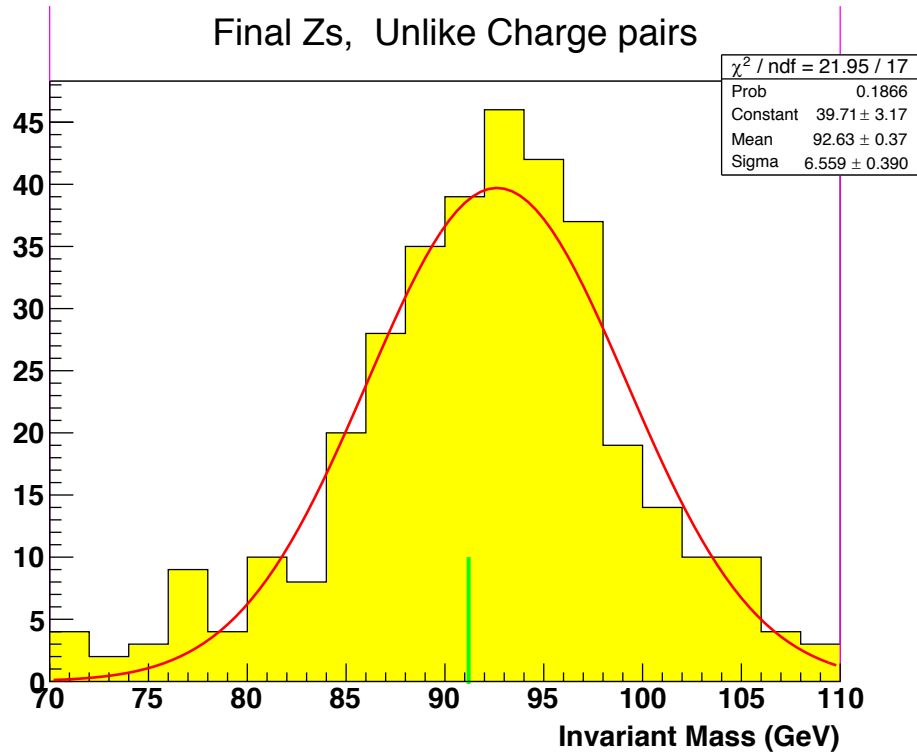
Jae D. Nam

Temple Univ.
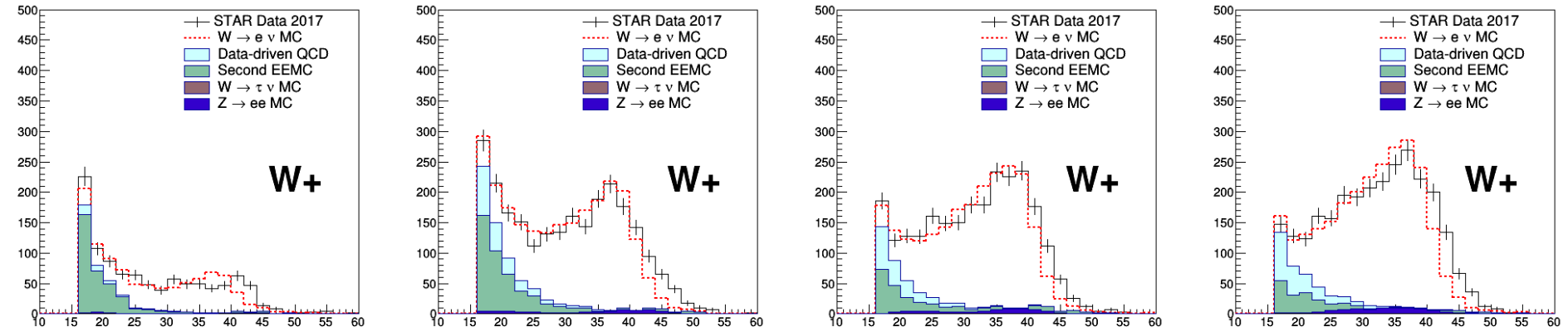
# Overview

- Full production of st_W and embedding
  - ~332 $pb^{-1}$ (2542 / 2691 runs) analyzed at the moment.
  - Uses final EMC calibration (P20ic).
  - EMC gain correction estimated with Z mass peak has **not** been included.
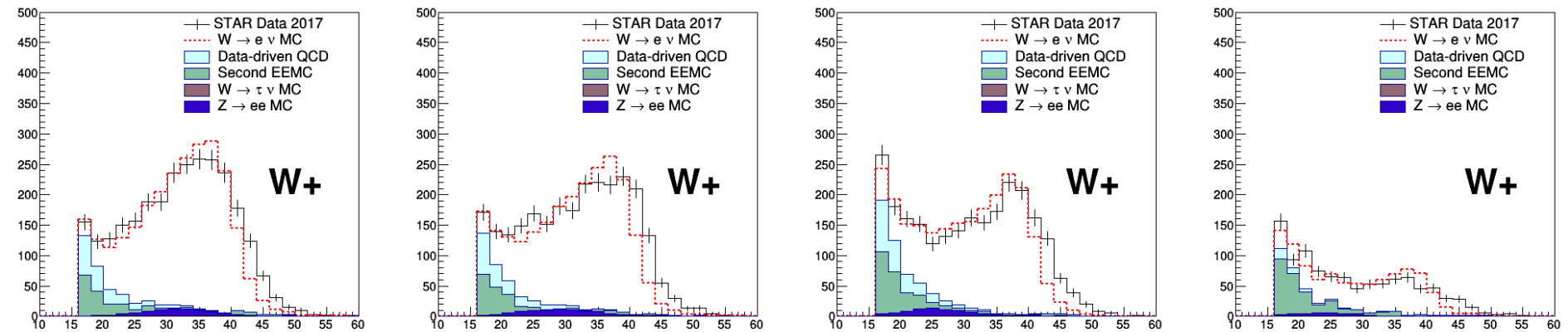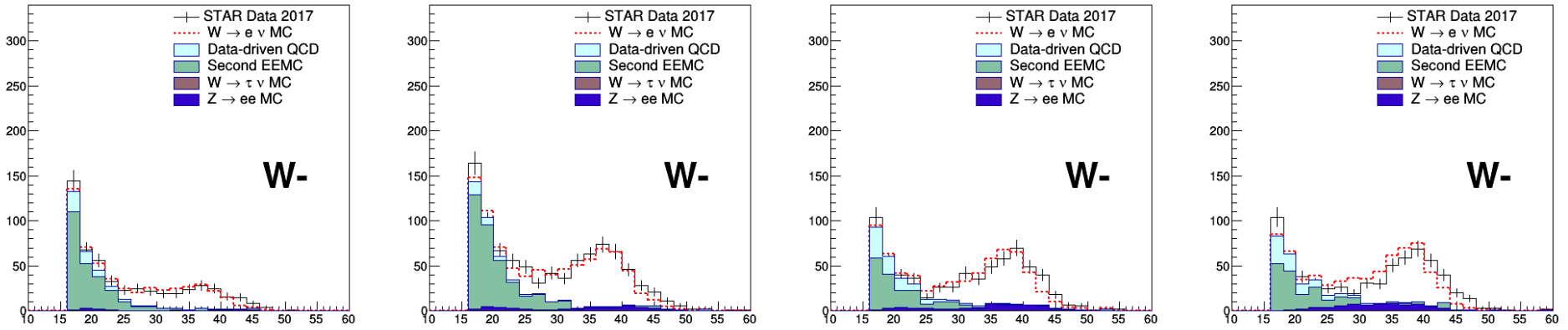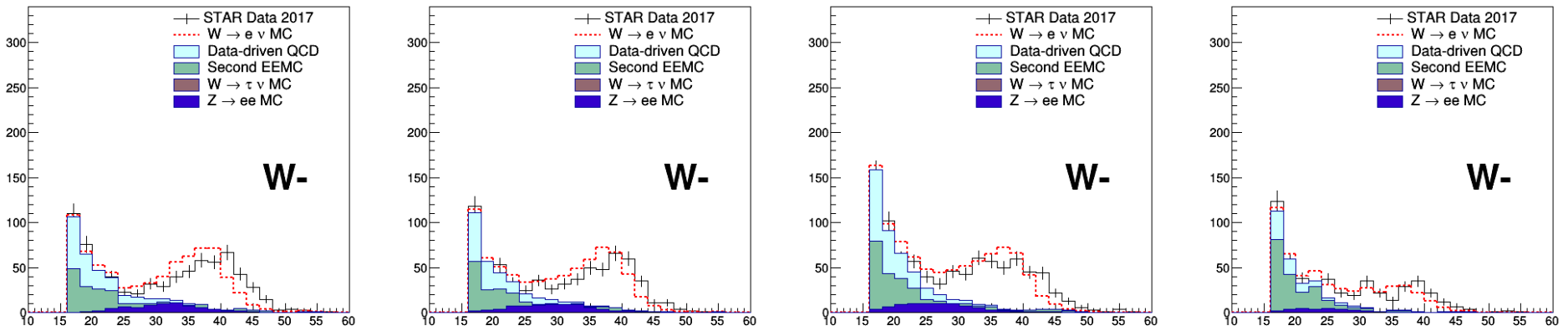  - TPC sector 20 excluded.



Final Zs, Unlike Charge pairs

| | |
|---|---|
| $\chi^2$ / ndf | 21.95 / 17 |
| Prob | 0.1866 |
| Constant | $39.71 \pm 3.17$ |
| Mean | $92.63 \pm 0.37$ |
| Sigma | $6.559 \pm 0.390$ |

Invariant Mass (GeV)



lastHit on track (W candidate)

detector phi (rad)

detector eta



TPC PRIM Charge Separation Hyperbola Corrected

| muChRecHypCorrPNp_py | |
|---|---|
| Entries | 23356 |
| Mean | 0.6084 |
| Std Dev | 1.037 |

Q*ET/PT

# $E_T (W^+)$

$$-1.0 < \eta < 0$$



$$0 < \eta < +1.0$$

# $E_T\,(W^-)$

$$-1.0\ <\eta<0$$



$$0\ <\eta<+1.0$$
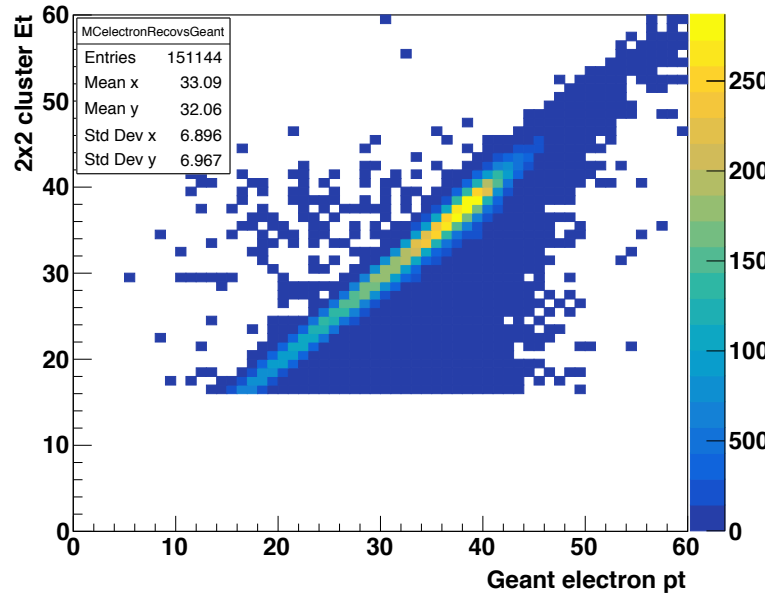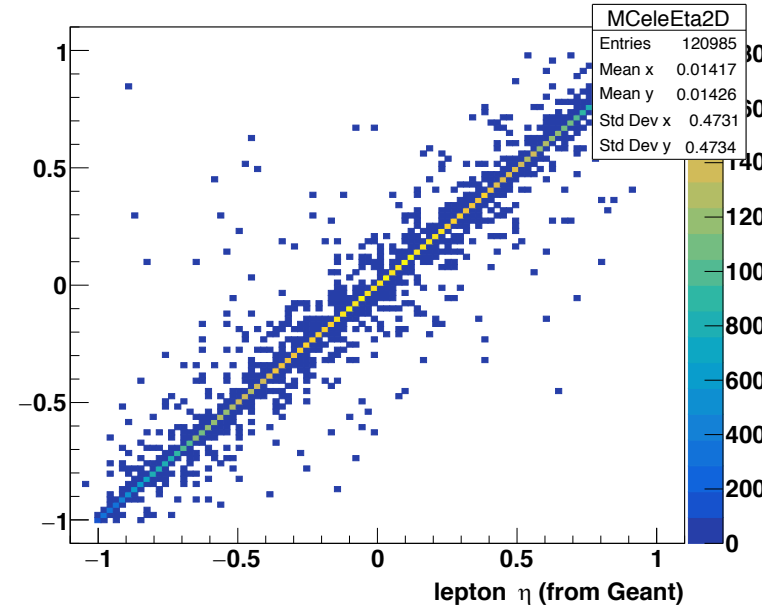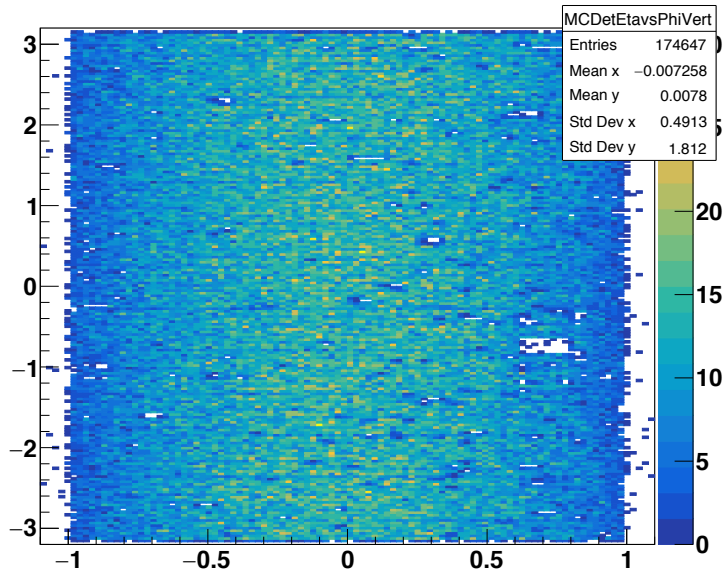
# MC quantities ($W^+$)

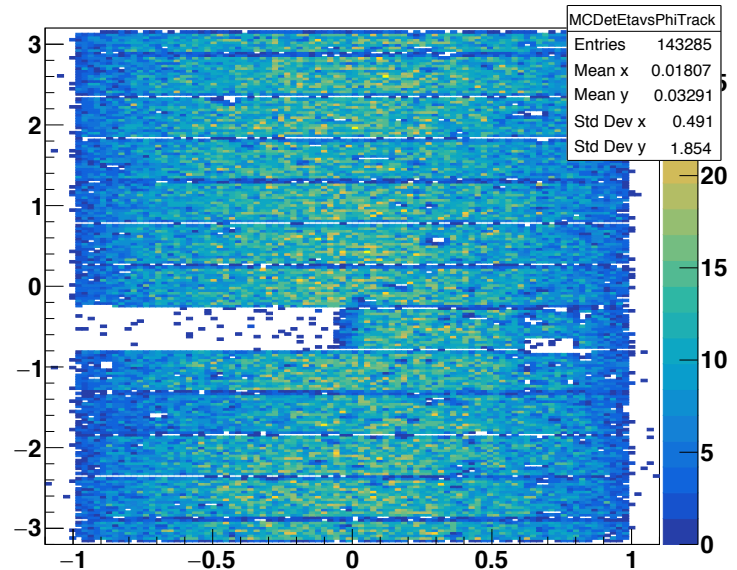Electron Reco pt vs Geant pt



reconstructed MC η vs True MC η of all leptons that pass W cuts



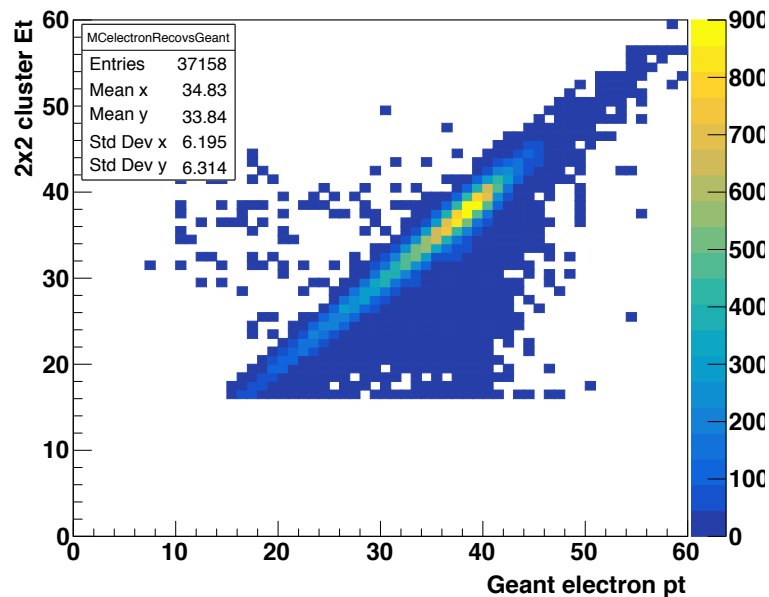Lepton Detector Eta vs. Phi (Pass Trig+Vertex+Track Cut)



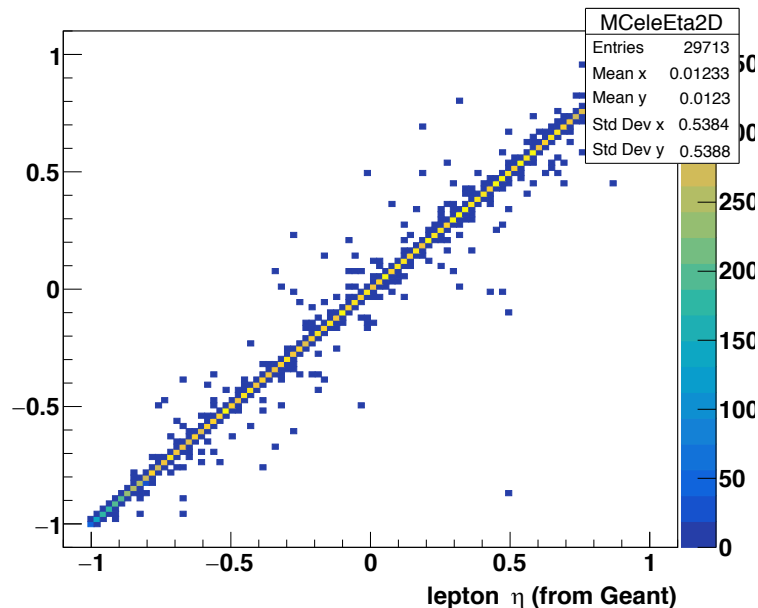Lepton Detector Eta vs. Phi (Pass Trig+Track Cut)
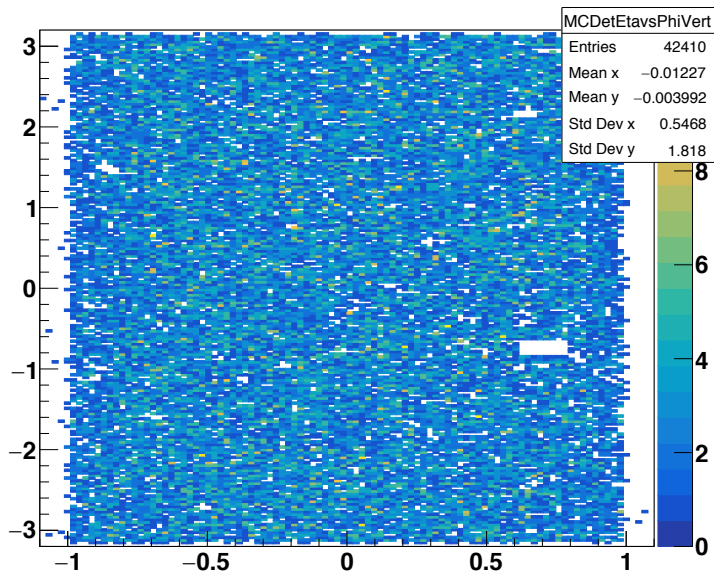
# MC quantities ($W^-$)
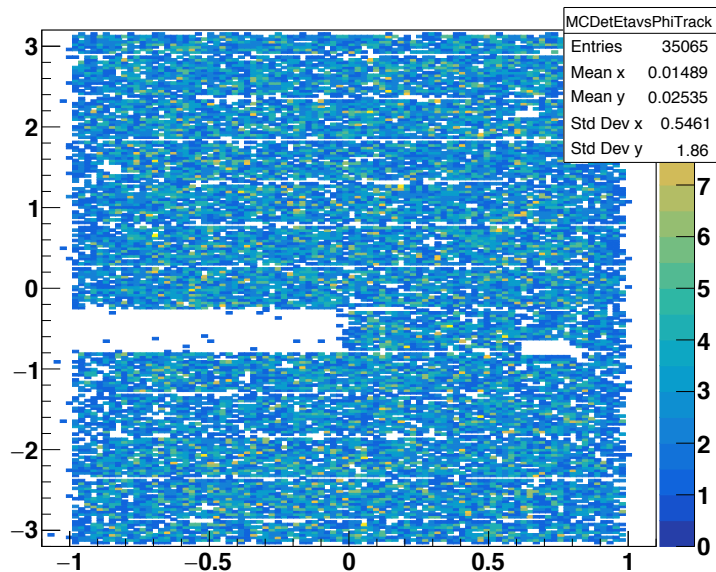


Electron Reco pt vs Geant pt

reconstructed MC η vs True MC η of all leptons that pass W cuts

Lepton Detector Eta vs. Phi (Pass Trig+Vertex+Track Cut)
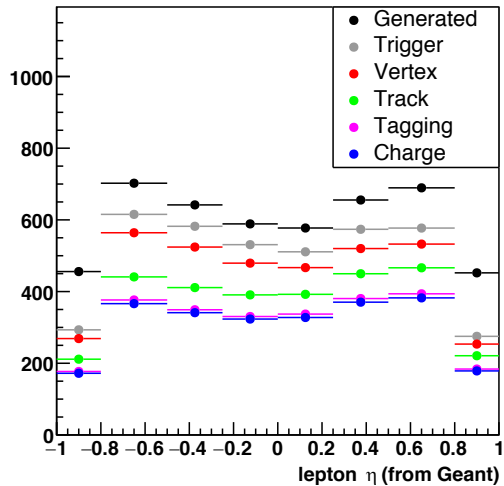
Lepton Detector Eta vs. Phi (Pass Trig+Track Cut)

# Efficiency

- The total efficiency reflects the sum of five different contributions within the kinematic region $E_T > 25 GeV$ and $|\eta| < 1.1$.

    1. Trigger efficiency: $\epsilon_{trg} = N_{trg}/N_{gen}$
        - lbitET triggered

    2. Vertex efficiency: $\epsilon_{vtx} = N_{vtx}/N_{trg}$
        - $Rank_{vtx} > 0$  &&
        - $|Z_{vtx}| < 100cm$  &&
        - $\left|Z_{vtx}^{rec} - Z_{vtx}^{gen}\right| < 2cm$

    3. Tracking efficiency: $\epsilon_{trk} = N_{trk}/N_{vtx}$
        - Vertex with non-zero electron track  &&
        - $p_T^{trk} > 10 GeV$

    4. Tagging efficiency: $\epsilon_{tag} = N_{eW}/N_{trk}$
        - Track matched to a cluster
        - $E_T^{cluster}/E_T^{near} > 0.82$
        - $p_{T,balance} > 16 \, GeV$

    5. Charge efficiency: $\epsilon_{chg} = N_{eW}^{\pm}/N_{eW}$
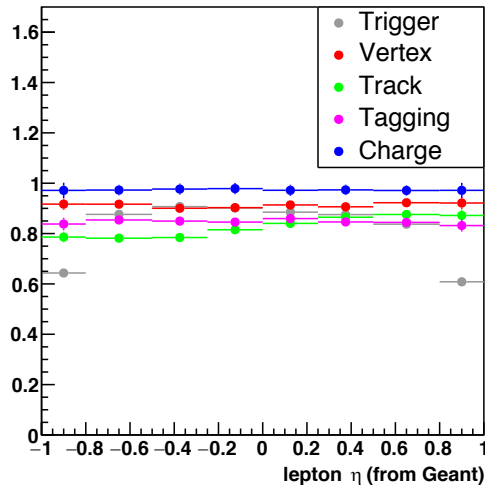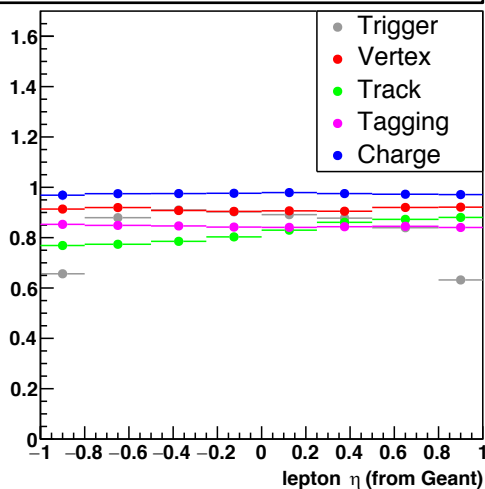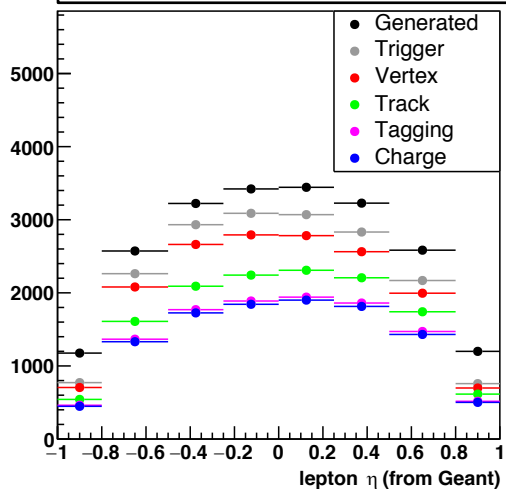        - $0.4 < |Q \times E_T/p_T| < 1.8$

# Efficiency ($\eta$)
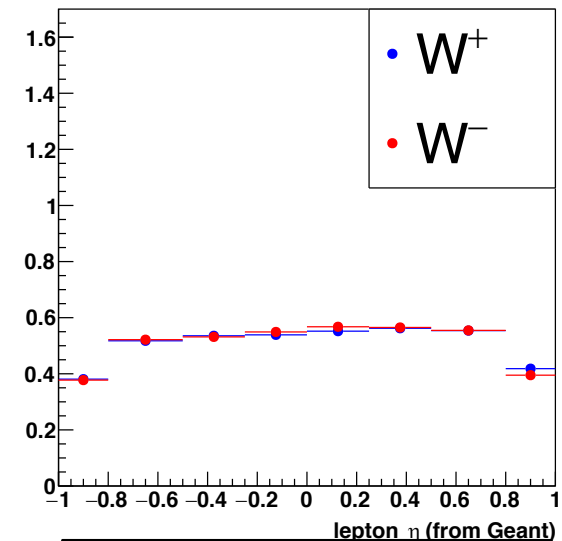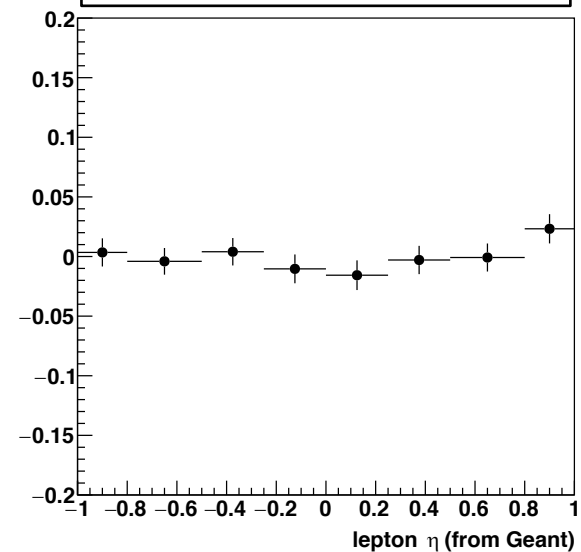
# Efficiency ($Z_{vtx}$)

# Efficiency ($p_T$)

# Efficiency ($p_T$)



$\epsilon^+ - \epsilon^-$

- Trigger
- Vertex
- Track
- Tagging
- Charge

A lot of the non-zero slope seems to have come from the trigger selection stage.

$\epsilon_{tot}$

- $W^+$
- $W^-$
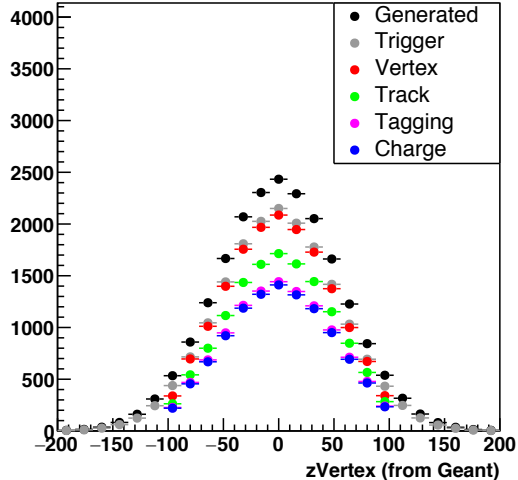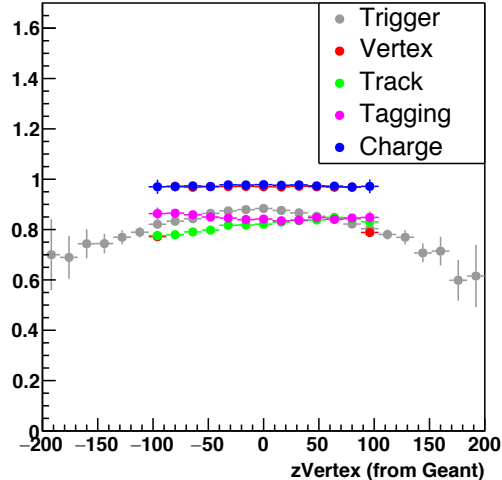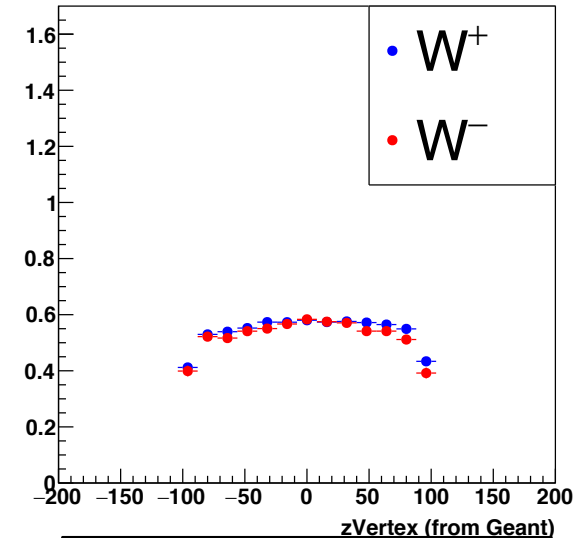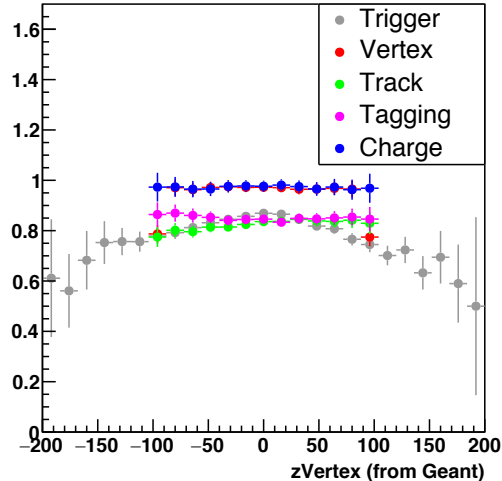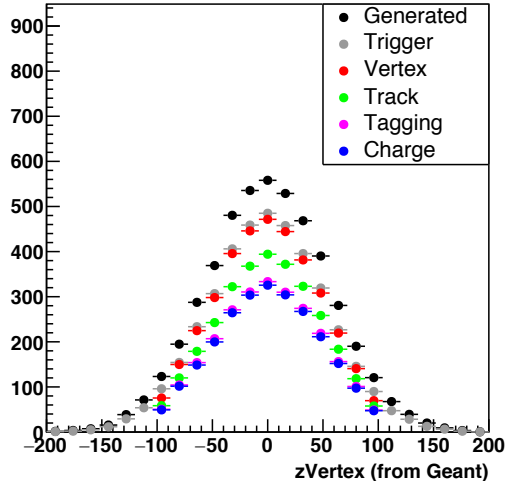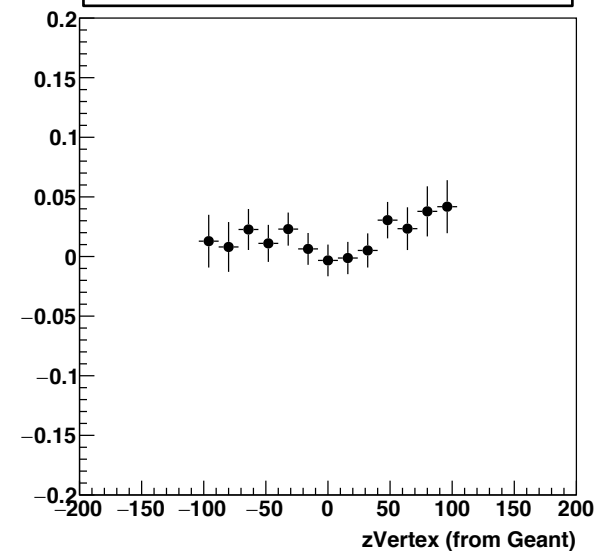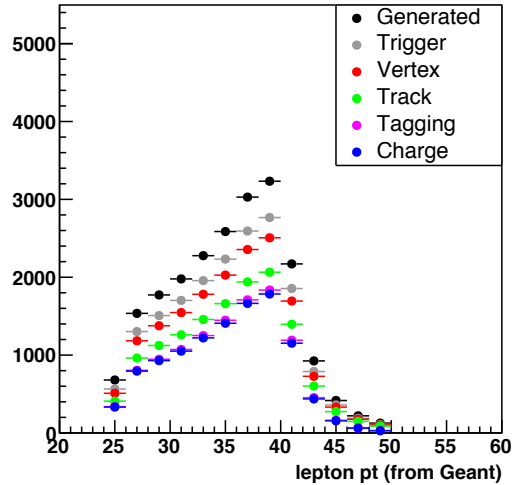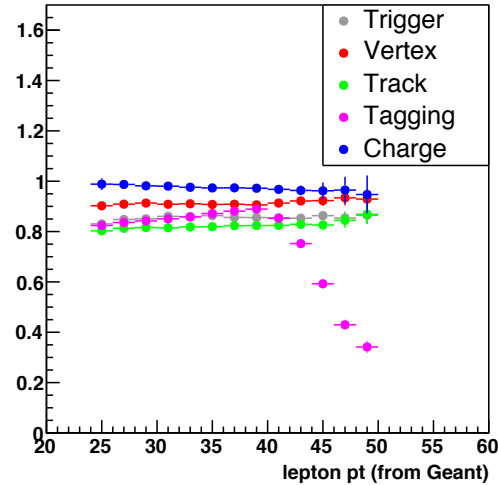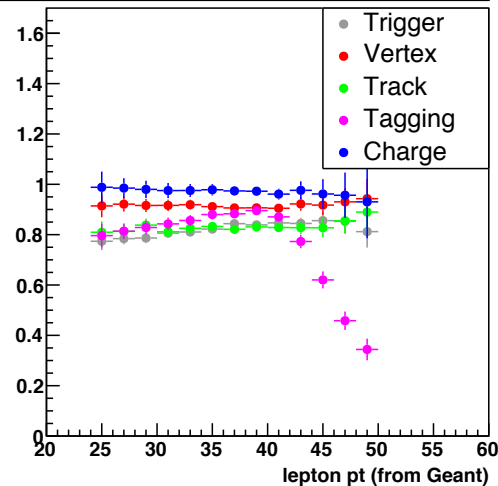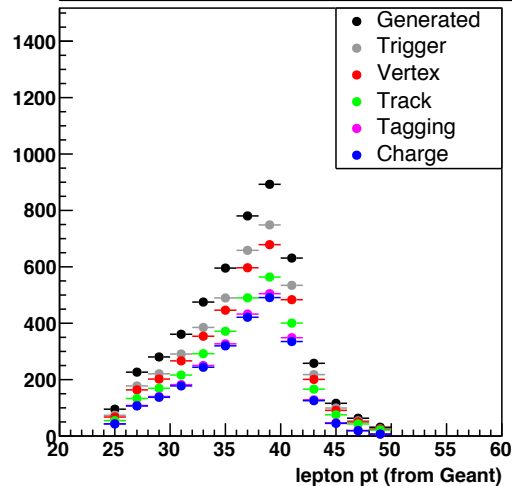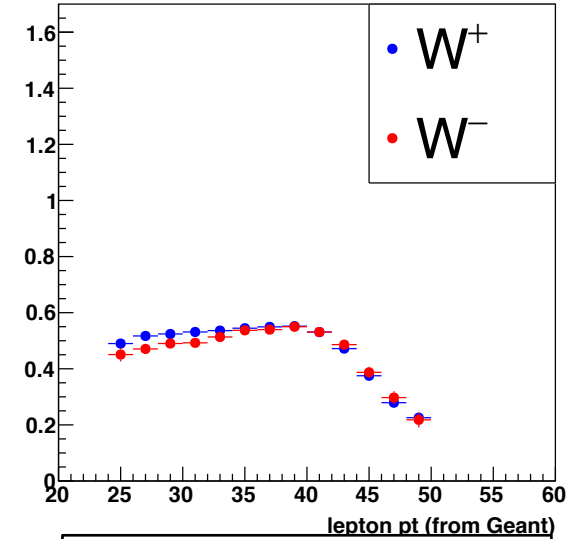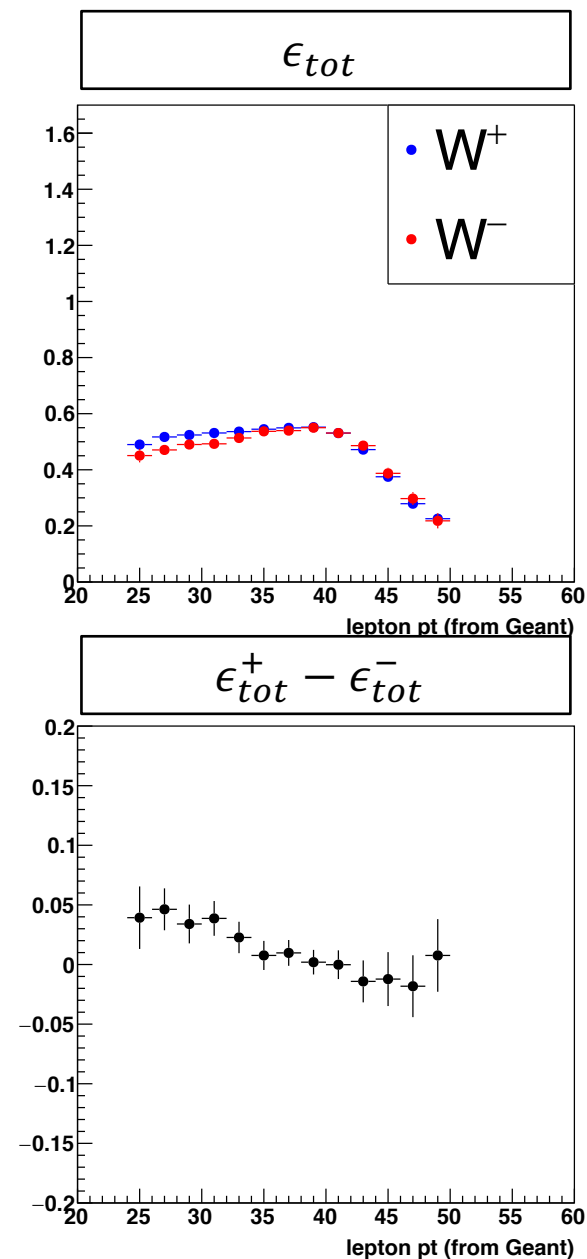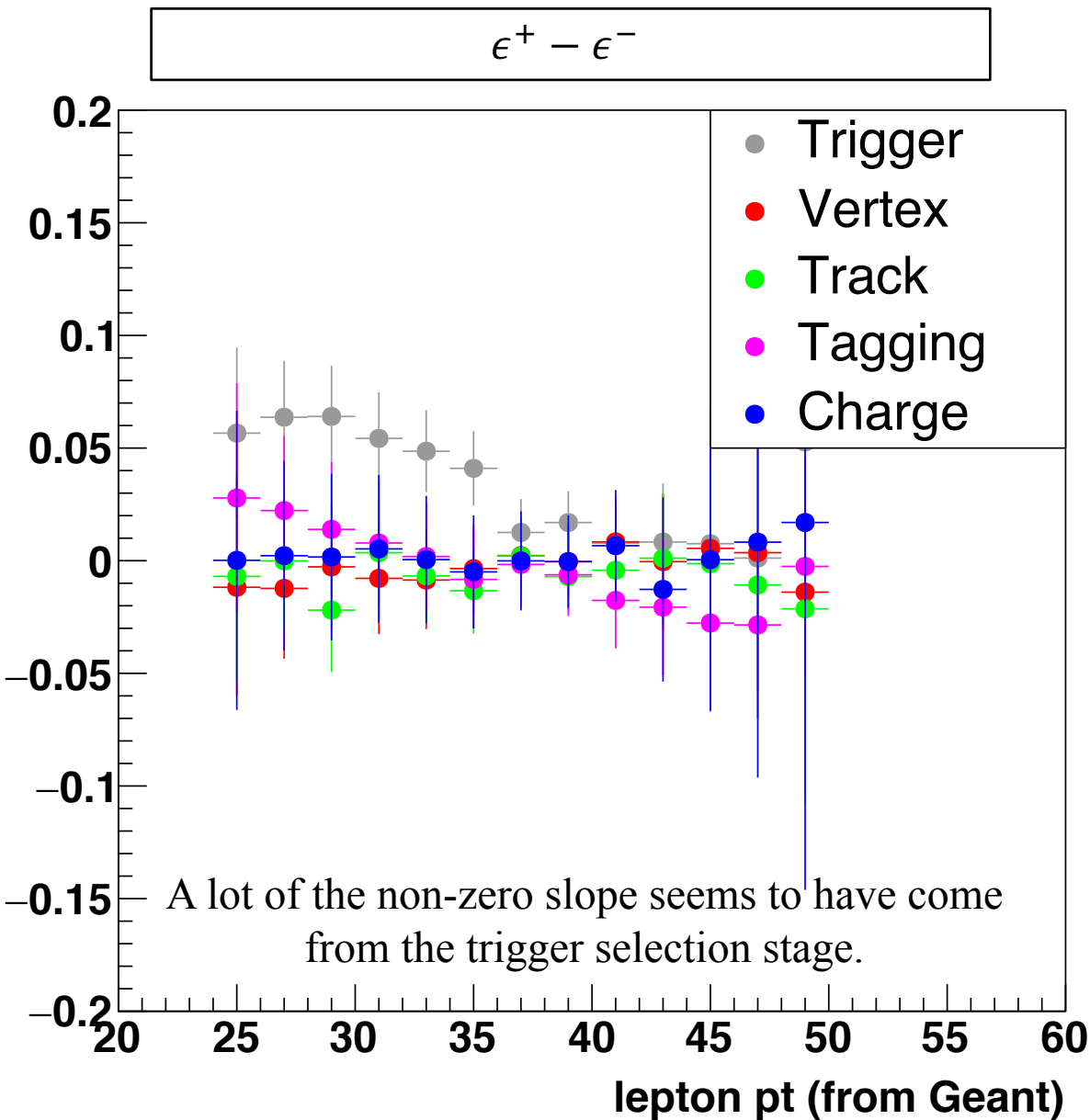
$\epsilon^+_{tot} - \epsilon^-_{tot}$
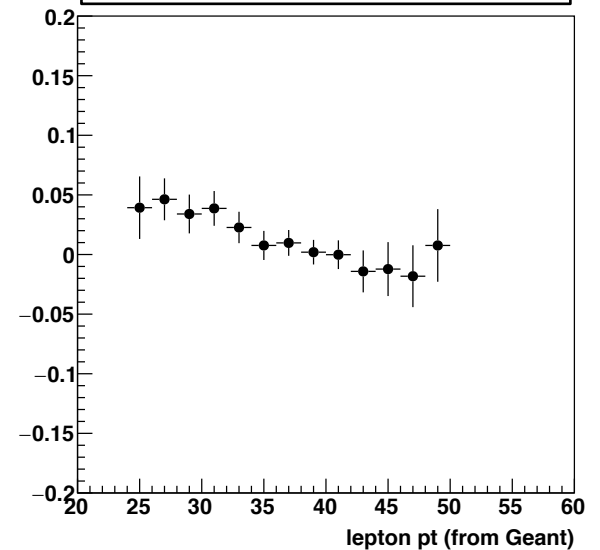
lepton pt (from Geant)

# Summary

- Production P20ic is complete.
    - Relatively good agreement between MC and data.
        - Wider Jacobian peak in data.
    - Good matching between true and reconstructed quantities.

- Efficiency study
    - Expected small efficiency correction in the barrel $\eta$ bins.
    - Systematic efficiency difference between $W^{\pm}$ with non-zero slope in lepton-$p_T$.
        - Seems to come at the trigger selection stage.

- To-do list
    - Endcap measurement
    - Systematic uncertainties