W^+/W^- cross-section ratio with STAR Run 2017

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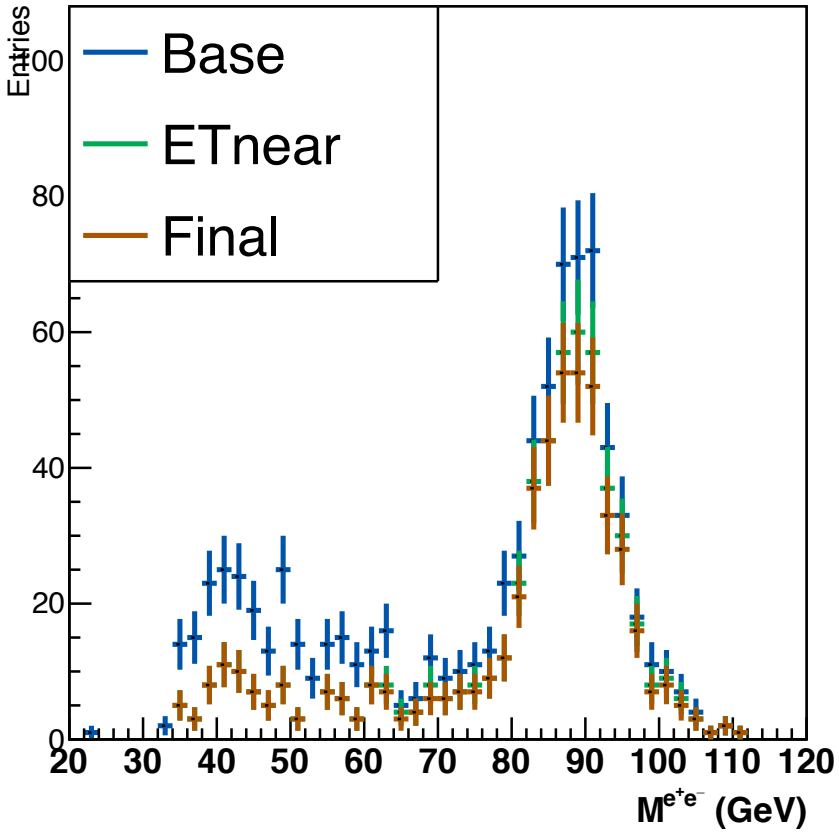
Recap

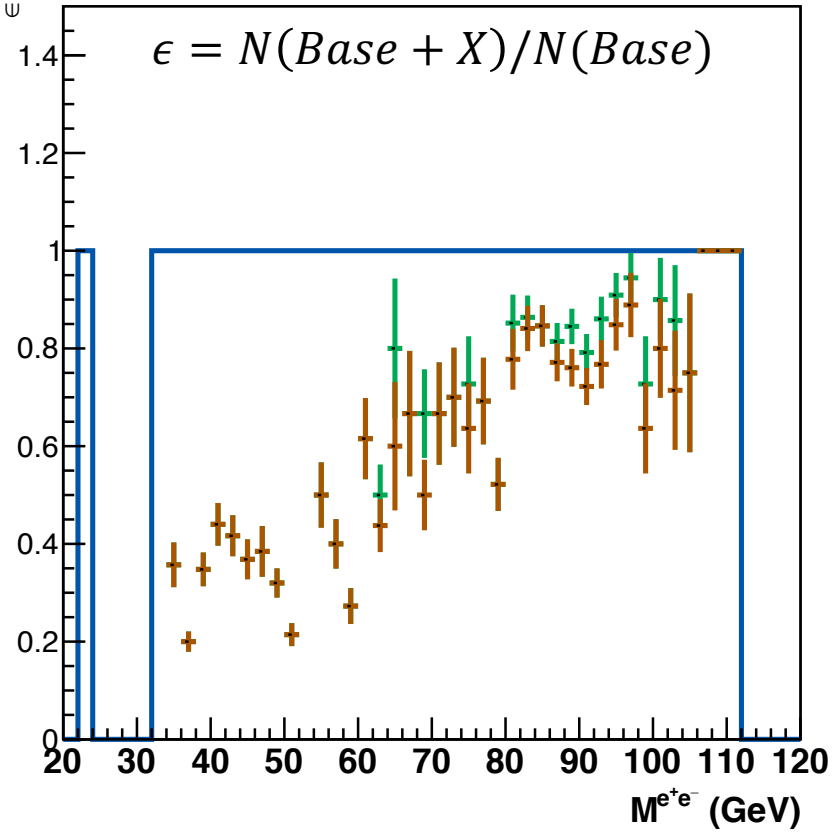
- Talk with Werner and Daniel
  - Scheduled for Early April
  - Pavel developing ResBos2 framework with NLL corrections

- Comparing W measurement with Z
  - Create mock W sample with Z data
  - Compare the effect of kinematic selection (ETaway, spTbal)

- Published $\sigma_{fid}(Z)$ also consistent with NLO+0J
  - ETnear mimicking ETaway?
  - **Two samples** with and without ETnear requirement

Looking at Z events (data)

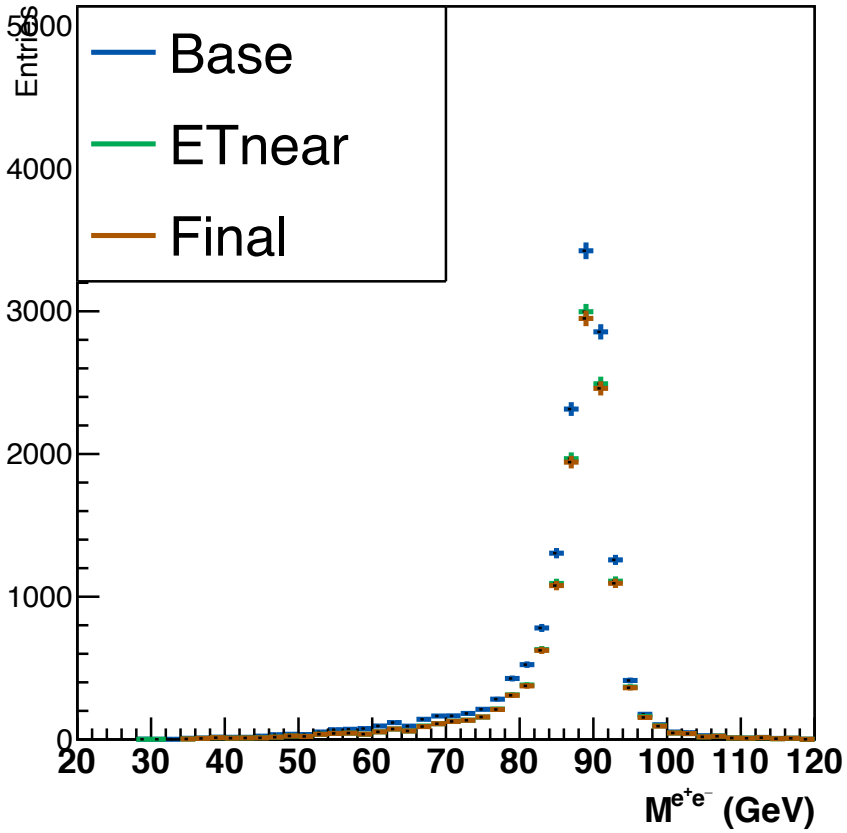


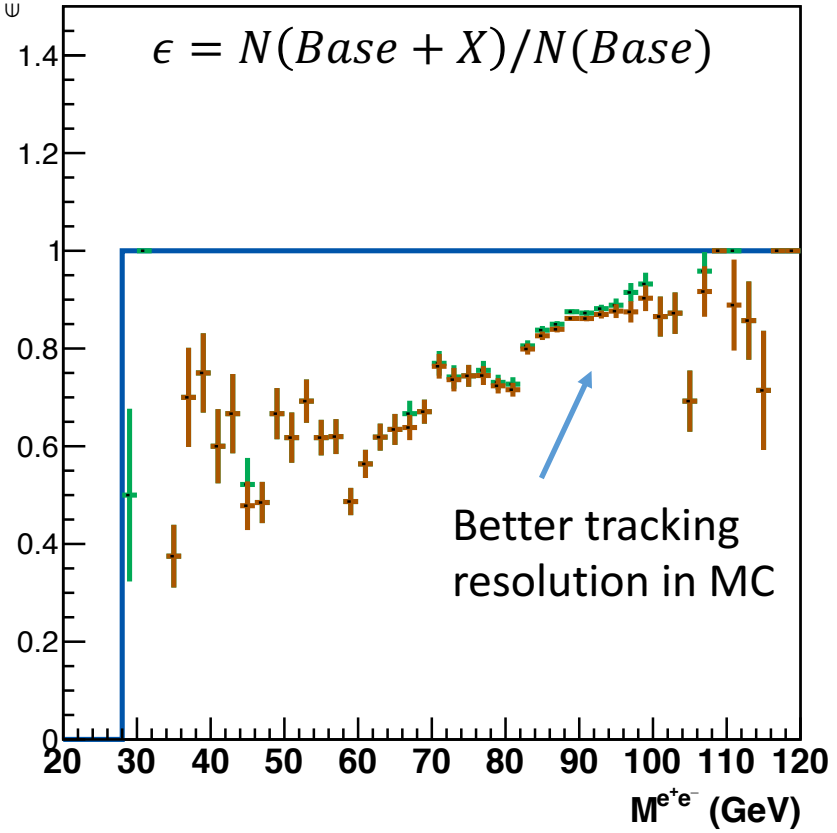


- Looking at the effect of ETnear cut with Z's for now
- **Base** = every requirement up to ETnear
- **Final** = Base + ETnear + dphi(e+e-) + qET/pT + Unlike-Sign

ETnear → Final mostly tracking resolution effects

Looking at Z events (MC)





- For candidates with $73\ GeV < M_{e+e-} < 114\ GeV$,
- ϵ(ETnear, Z, data) $= 0.820 \pm 0.0007$
- ϵ(ETnear, Z, MC) $= 0.850$
- MC reproduces ETnear efficiency well

Where is 30% shift in Z coming from?

Strategy for W

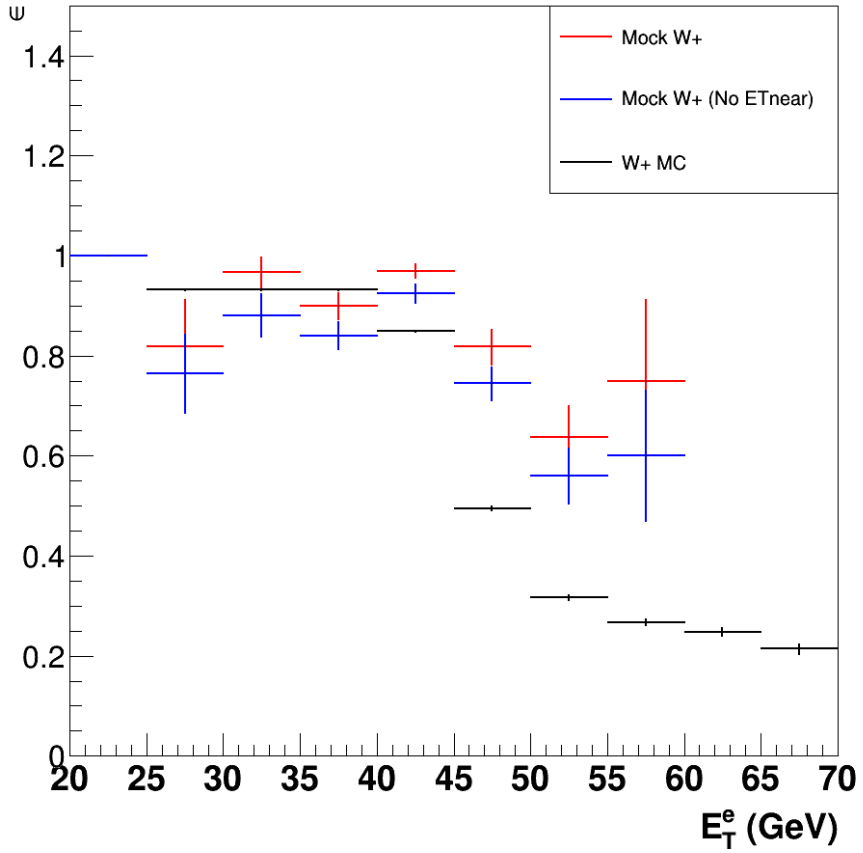
- Mock-W sample is obtained by:
  - Reconstructed Z events from data ($73\ GeV < M_Z < 114\ GeV$) with one electron blinded
  - New kinematic quantities are obtained as
    - $E_{T,away,+} \rightarrow E_{T,away,+} + \left(\hat{p}_{T,+} \cdot \hat{p}_{T,-} \cdot E_{T,-}^{2\times2}\right) + \left(\hat{p}_{T,+} \cdot p_{T,-}\right)$
    - signed-$p_{T,bal,+}$ → signed-$p_{T,bal,+} + \left(\hat{p}_{T,+} \cdot \hat{p}_{T,-} \cdot E_{T,-}^{2\times2}\right)$
  - **Signed-pTbalance** is reconstructed with **jets** (min-pT = 3.5 GeV)
    → lingering soft jets may increase spTbal slightly
    ($< 3.5\ GeV$ for some events)

- Mis-estimated efficiency correction factor

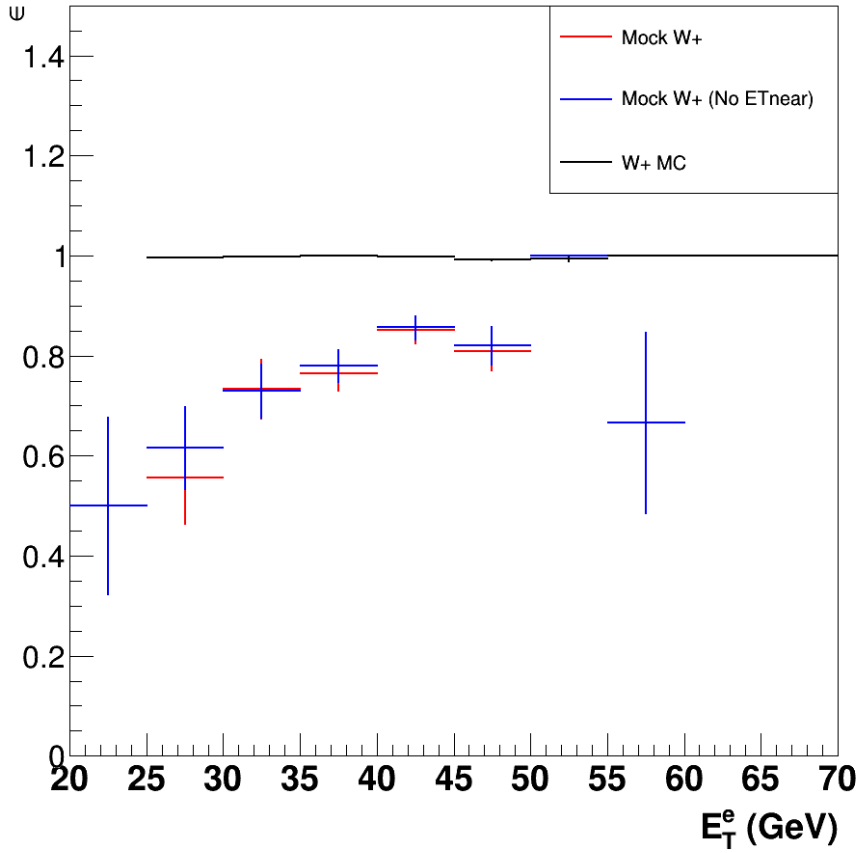
$$c_{eff} = \left(\frac{\epsilon_{MC,W}}{\epsilon_{Zdata,mockW}}\right)_{E_{T,away}} \times \left(\frac{\epsilon_{MC,W}}{\epsilon_{Zdata,mockW}}\right)_{sp_{T,bal}}$$

ETaway and spTbal Efficiencies (W+)

$\epsilon = N(\text{Base+}\mathbf{\text{ETaway}}) \,/\, N(\text{Base})$



$\epsilon = N(\text{Base+ETaway+}\mathbf{\text{spTbal}}) \,/\, N(\text{Base+ETaway})$

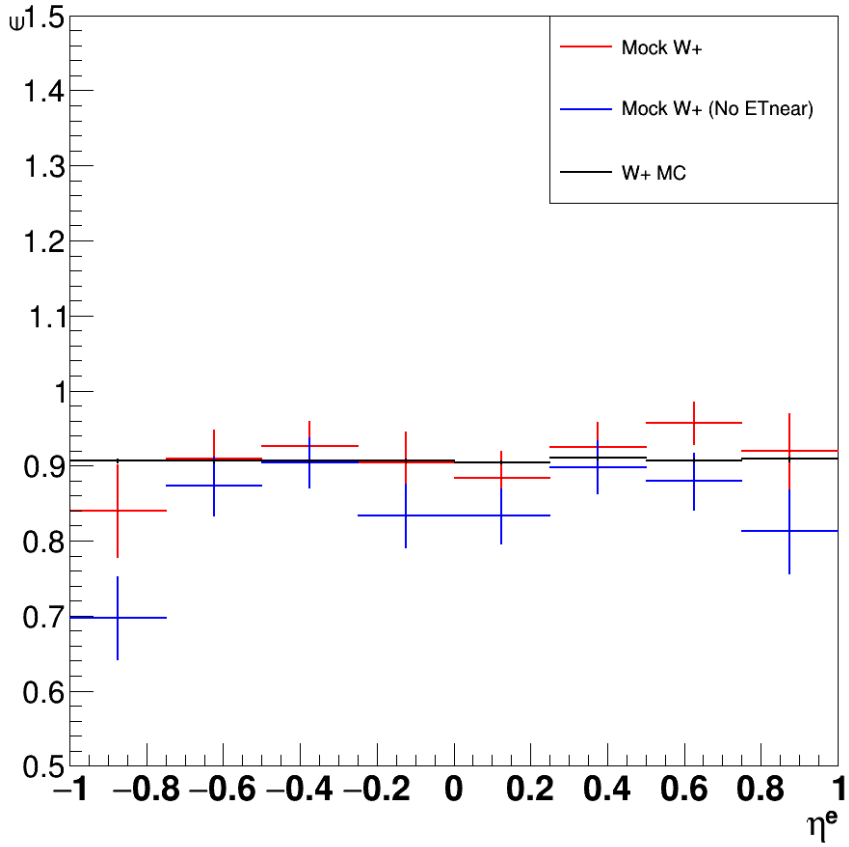


- Enhancement around Jaco. in mock-W sample, especially with spTbal cut.
- This is not seen from MC sample (didn't MC jet describe data well?)
  → Good data-jet description by MC **after** spTbal cut
  → No further correction mentioned in LHC papers

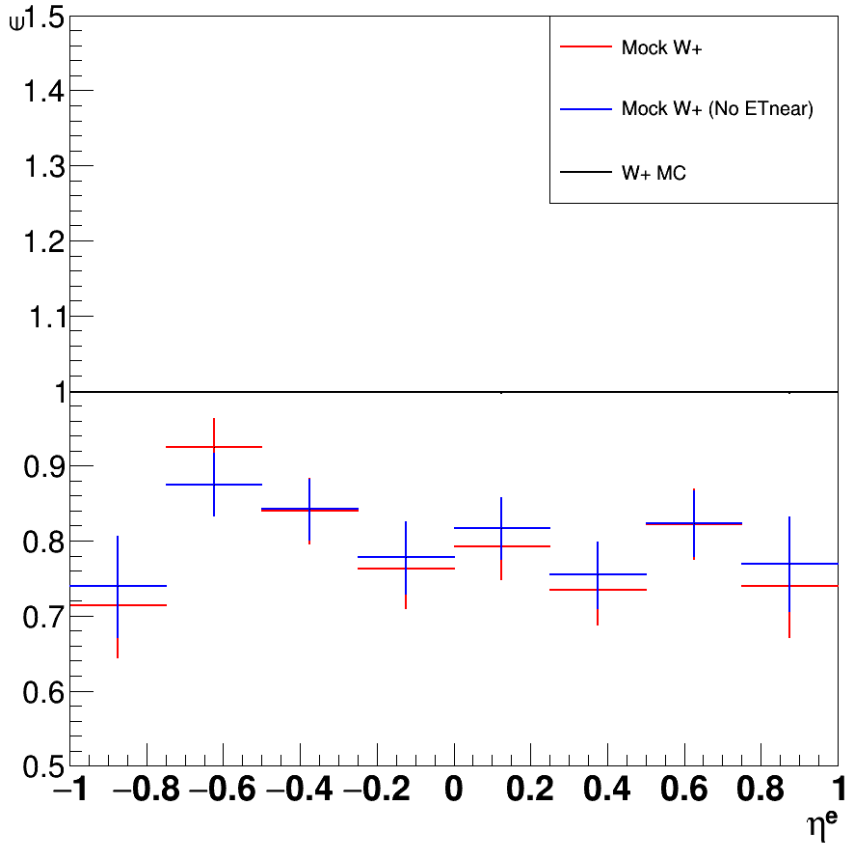
Better description expected from NLO+PS models (+NLL)

ETaway and spTbal Efficiencies (W+)

$\epsilon = N$(Base+**ETaway**) / N(Base)



$\epsilon = N$(Base+ETaway+**spTbal**) / N(Base+ETaway)



- Only looking at candidates with $25\ GeV < E_T < 50\ GeV$ (fiducial)
- Assumption: ETaway and spTbal efficiency is independent of η^e

ETaway and spTbal Efficiencies (W+)

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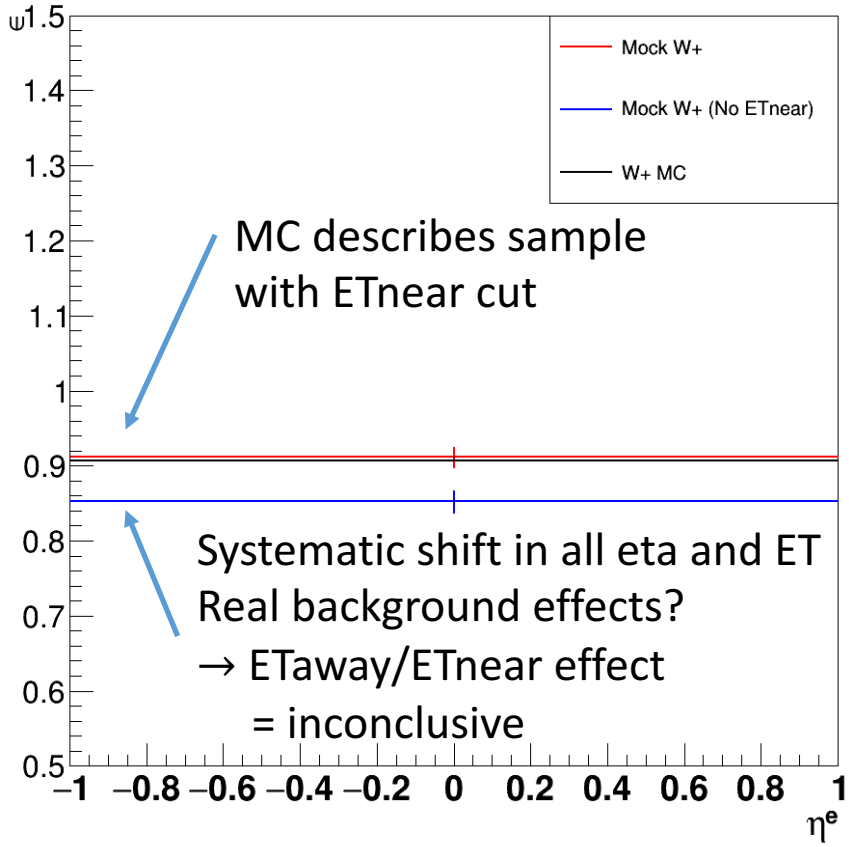

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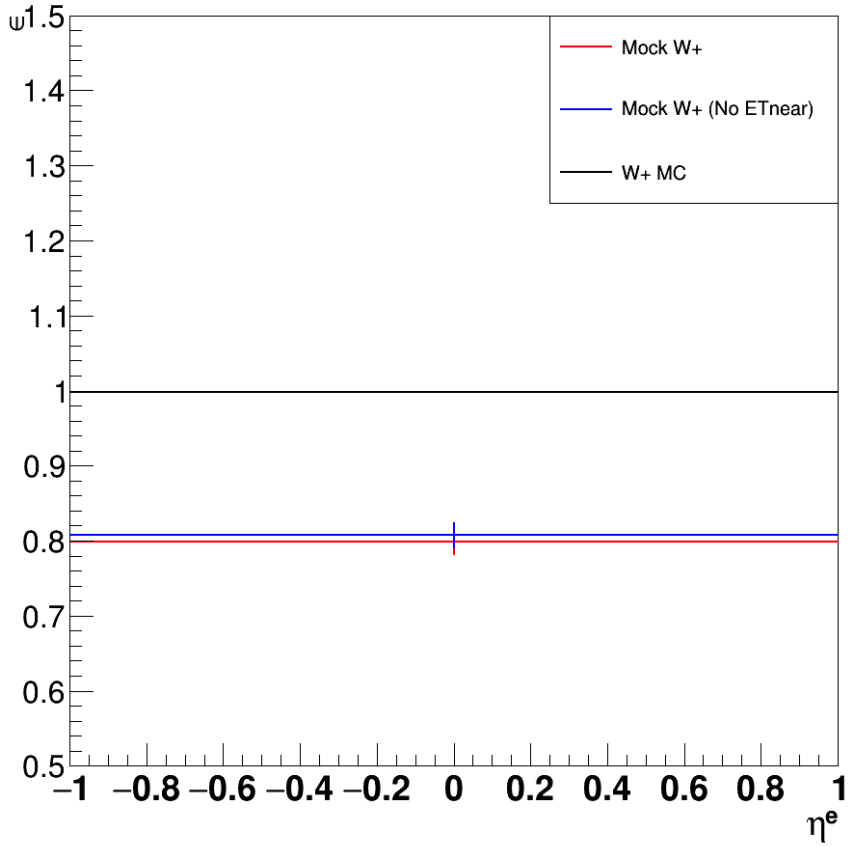
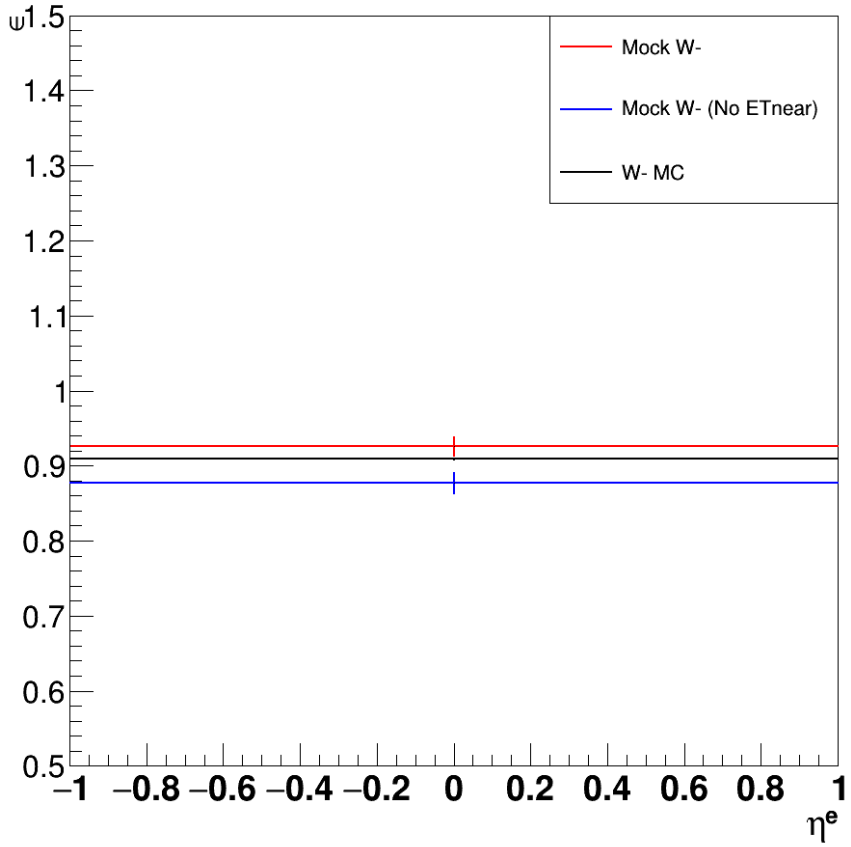


- $c_\epsilon = \left(\frac{\epsilon_{MC}}{\epsilon_{mock}}\right)_{ETaway} \cdot \left(\frac{\epsilon_{MC}}{\epsilon_{mock}}\right)_{spTbal}$ $= \frac{0.911}{0.907} \cdot \frac{0.998}{0.799} = 1.24$ (nominal)

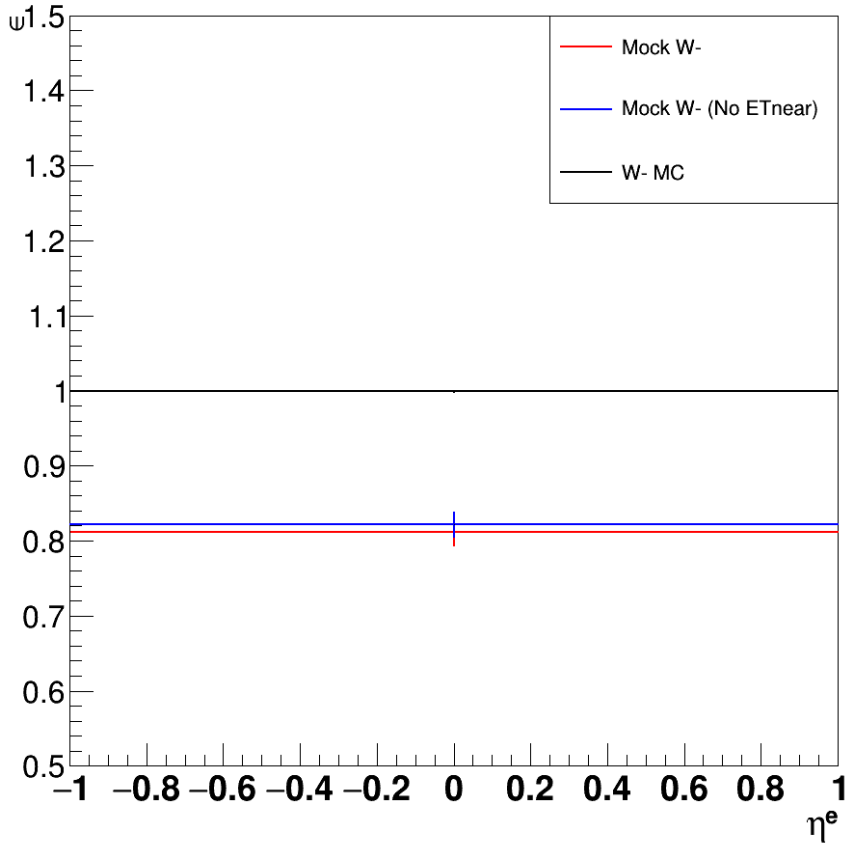
  $= \frac{0.907}{0.852} \cdot \frac{0.998}{0.807} = 1.32$ (w/o ETnear, alt.)

ETaway and spTbal Efficiencies (W-)

$\epsilon = N$(Base+**ETaway**) / N(Base)



$\epsilon = N$(Base+ETaway+**spTbal**) / N(Base+ETaway)



- $C_\epsilon = \left(\frac{\epsilon_{MC}}{\epsilon_{mock}}\right)_{ETaway} \cdot \left(\frac{\epsilon_{MC}}{\epsilon_{mock}}\right)_{spTbal} = \frac{0.909}{0.927} \cdot \frac{0.998}{0.811} = 1.21$ (nominal)

$= \frac{0.909}{0.877} \cdot \frac{0.998}{0.821} = 1.26$ (w/o ETnear, alt.)

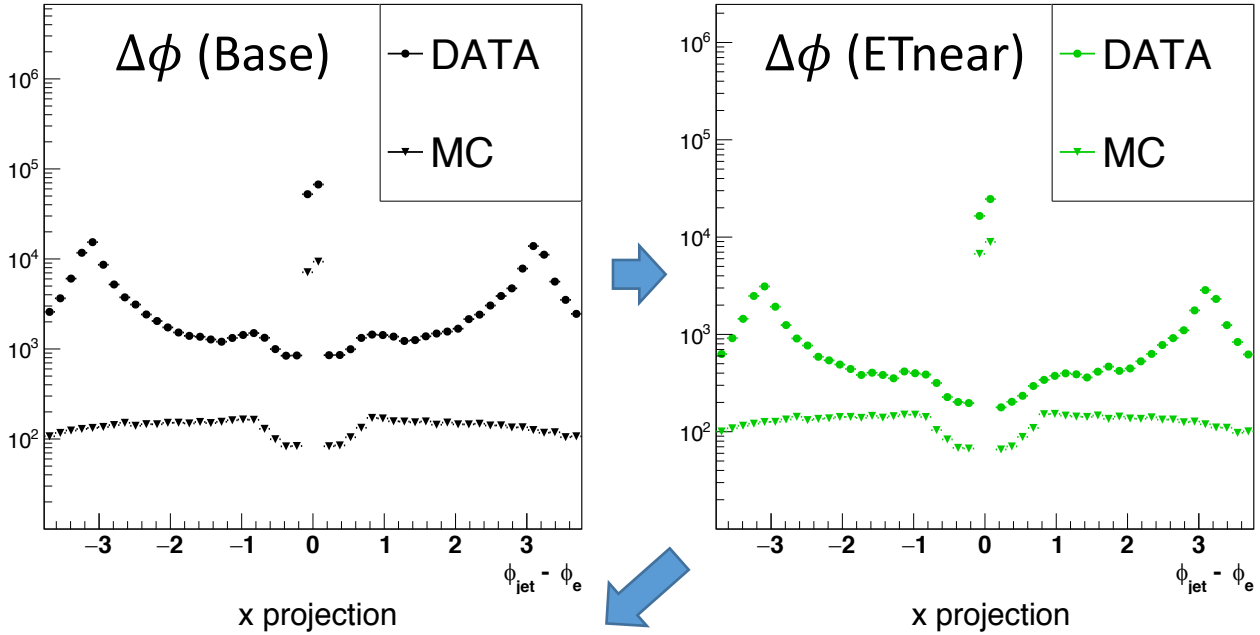
Summary

- Z MC simulates ETnear effect well
- Mis-estimation of ETaway efficiency → Inconclusive
- MC underestimates signed-$p_{T,bal}$ efficiency by ~20%
- η dependence → consistent with 0, limited by statistics
- The resulting correction factors, taking (nom.) $\pm$ (nom. $-$ alt.)
  - $c_{eff} = 1.24 \pm 0.08$ for W^+
  - $c_{eff} = 1.21 \pm 0.05$ for W^-
- Questions
  - Have we isolated NLO-LO shift into mis-estimation of spTbal efficiency?
  - Where is the Z mismatch coming from?

  → Sharing this finding with Pavel, Werner, Daniel

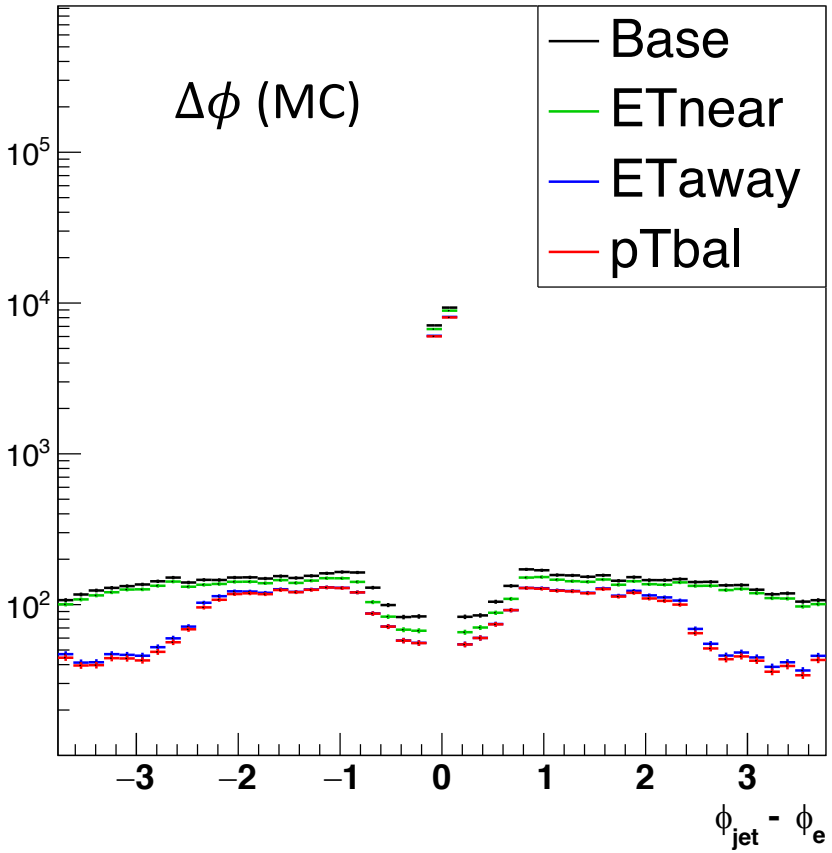
  → Chat with Z experts

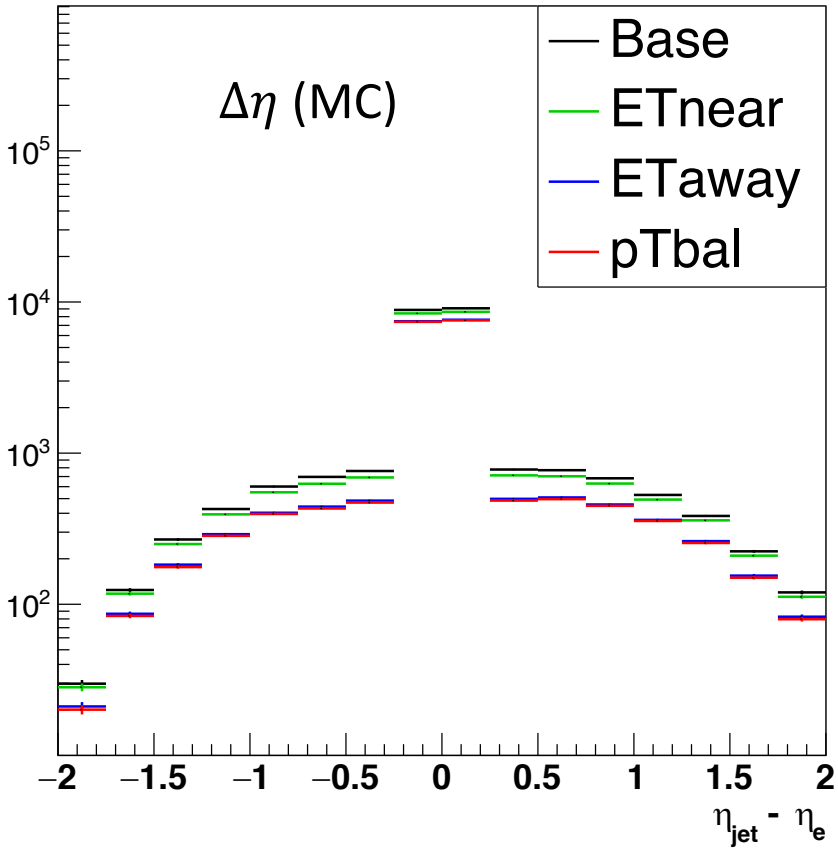
Didn’t MC jet describe data well?



- MC describes data well after the final selection cut (pTbal)
- Based on the Z study, it seems pTbal selection cuts out “good” jet events
- No mention of further corrections in LHC papers for their pTbal selection
  → better jet description expected from NLO+PS models

Do I believe $\epsilon_{MC,spTbal} \sim 1$?





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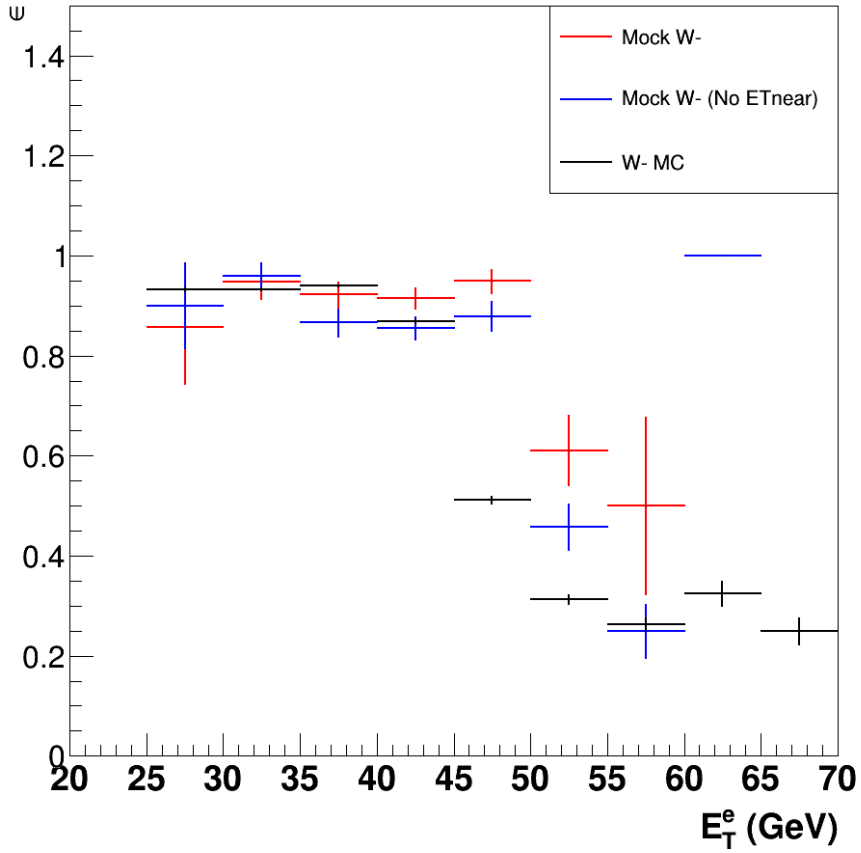

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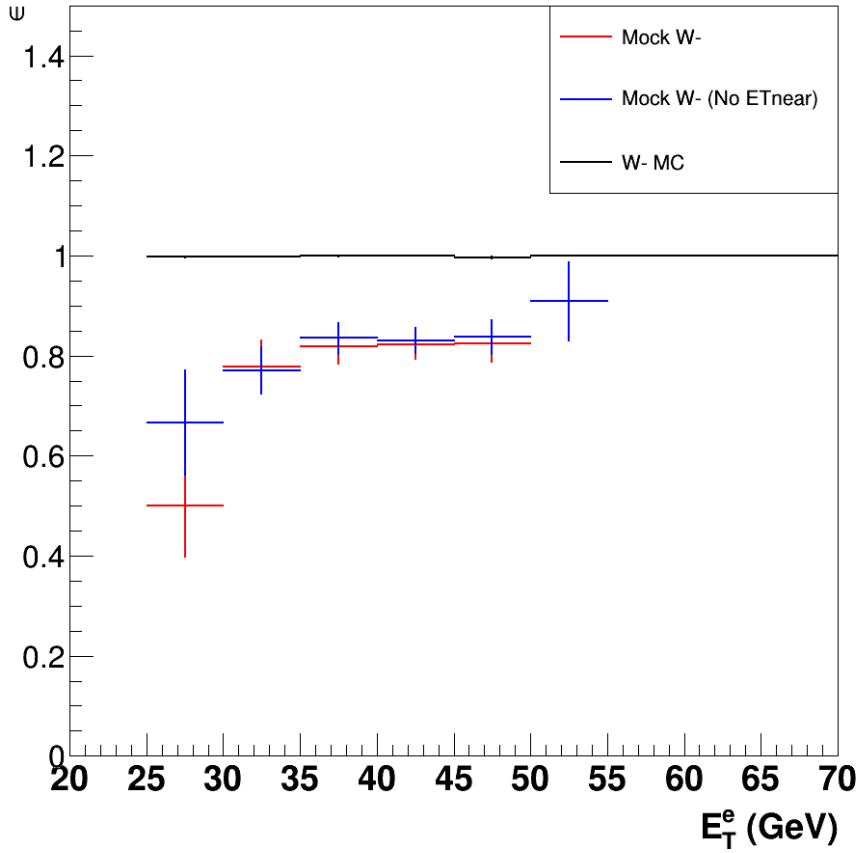

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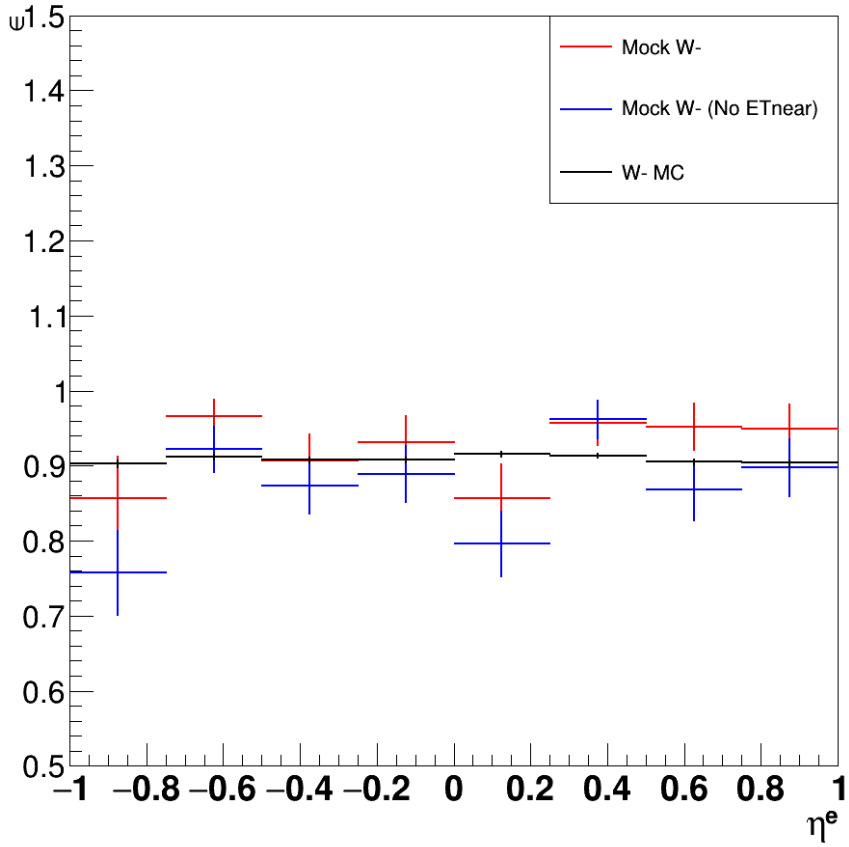
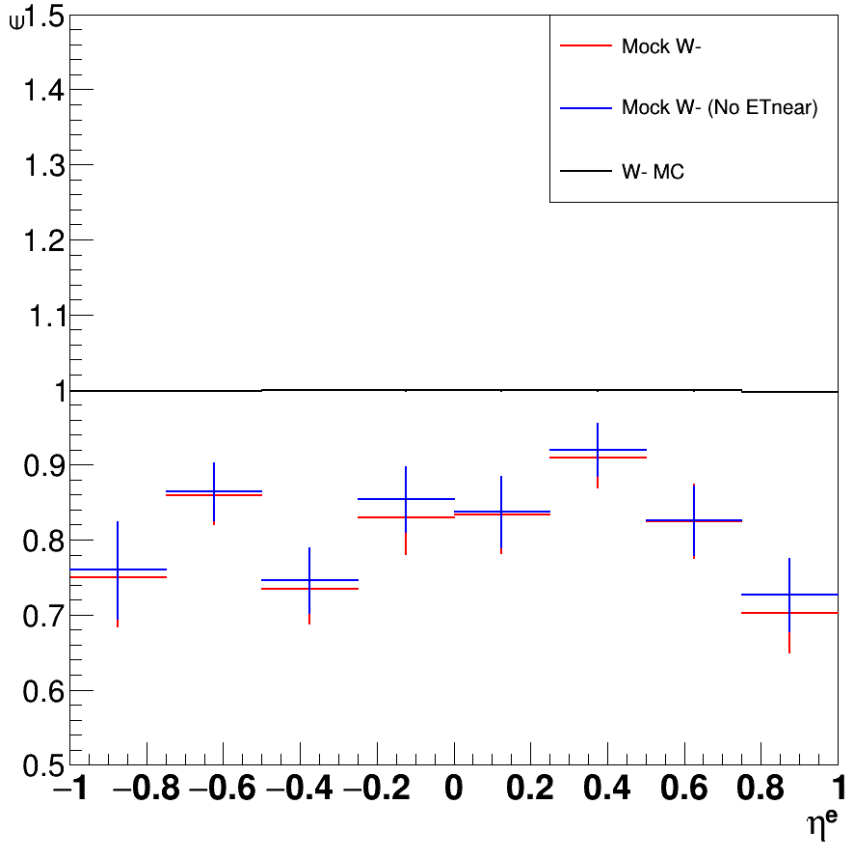


$\epsilon = N$(Base+ETaway+**spTbal**) / N(Base+ETaway)



ETaway and spTbal Efficiencies (W+)

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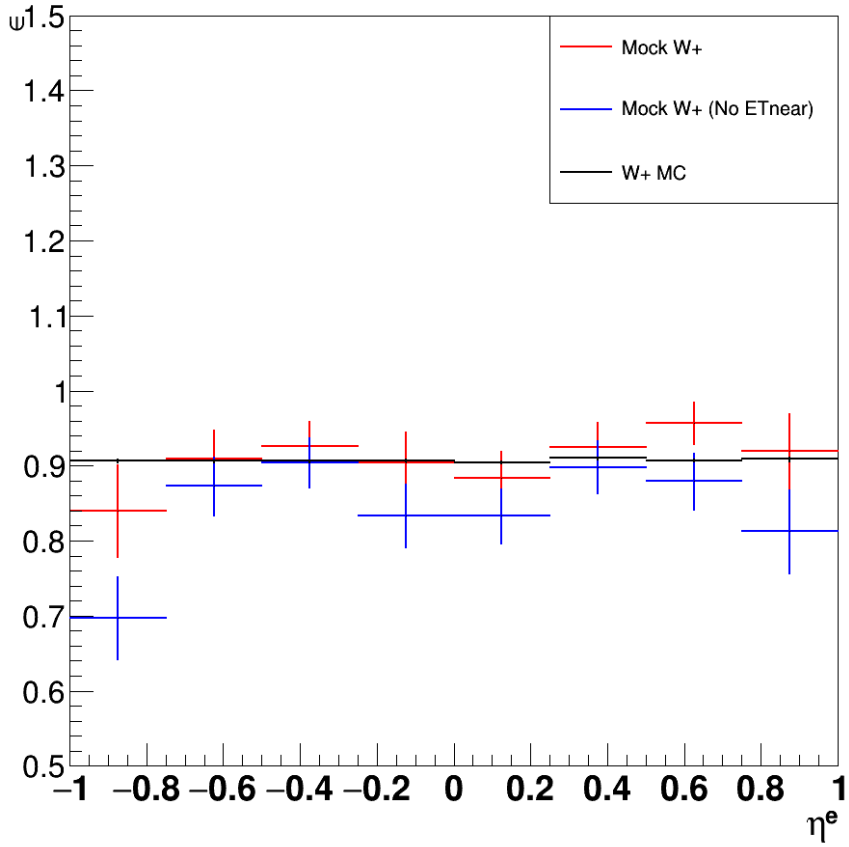

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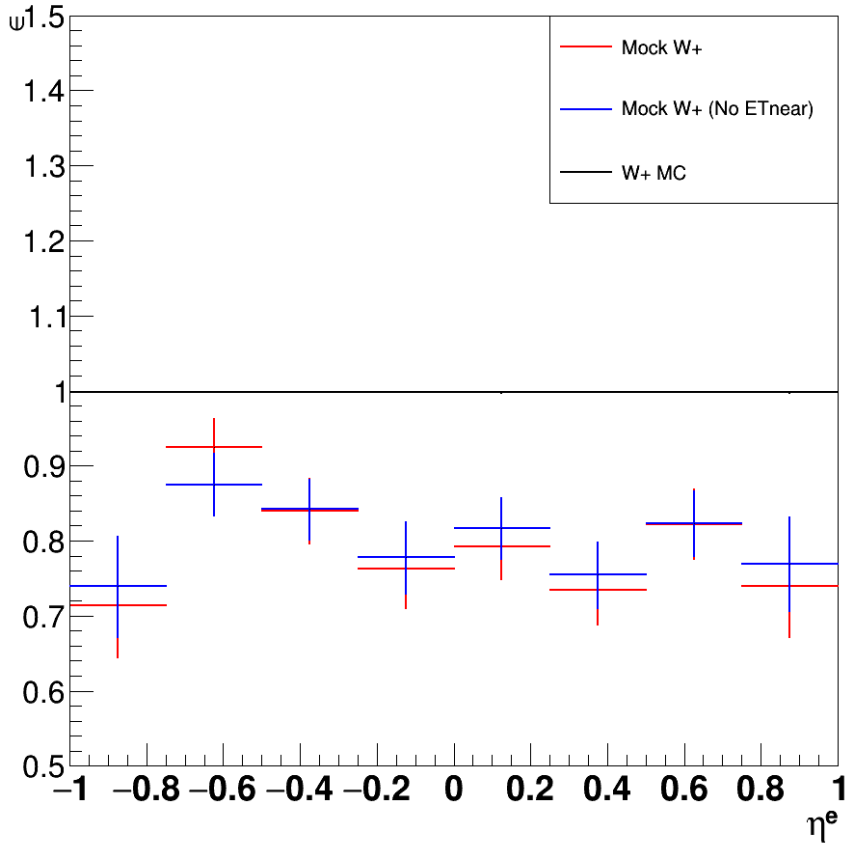

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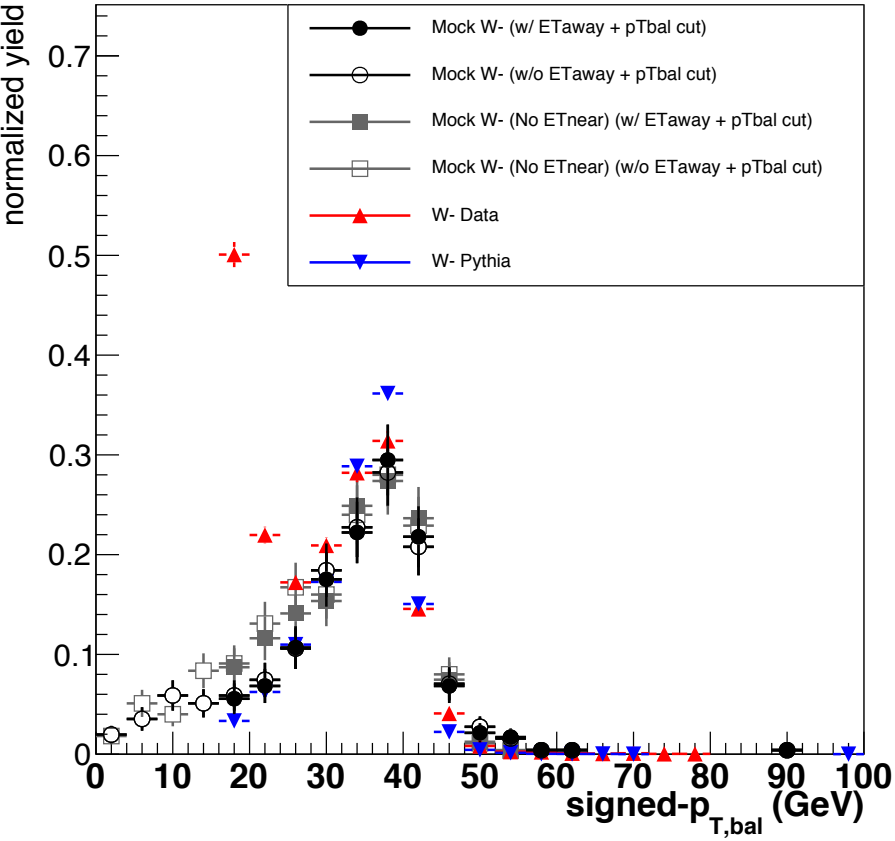
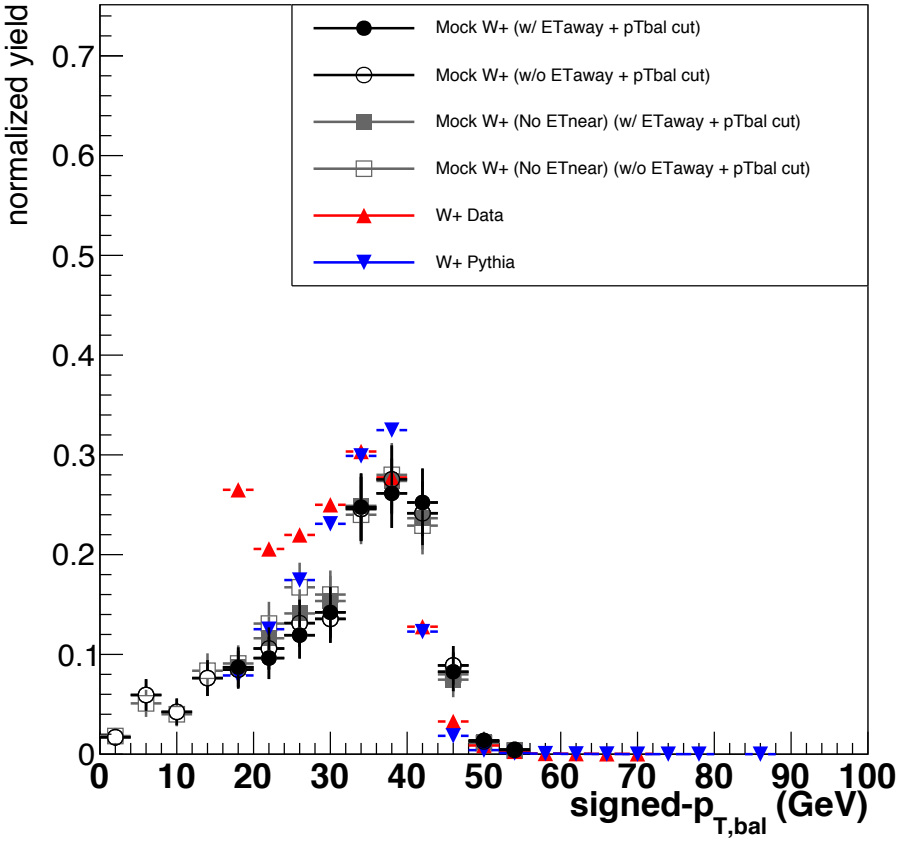
How does spTbal look?





- Quick and dirty normalization: 30 GeV < spTbal < 50 GeV
- Data + Pythia = ETaway (< 11 GeV) & spTbal (> 16 GeV) cut included
- No 25 GeV < ET < 50 GeV requirement at this point → New plots underway