W charge asymmetry at CDF

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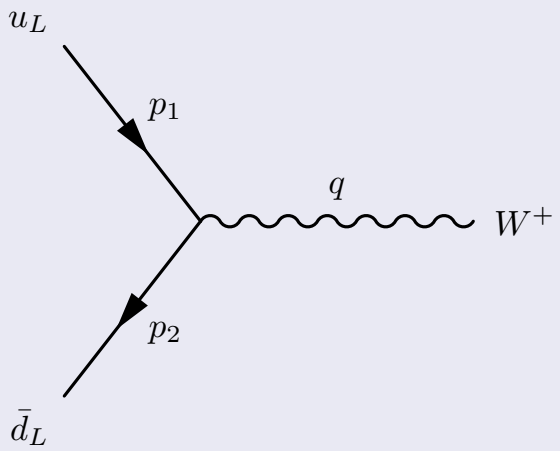
Plan of presentation

W^+ production and decay

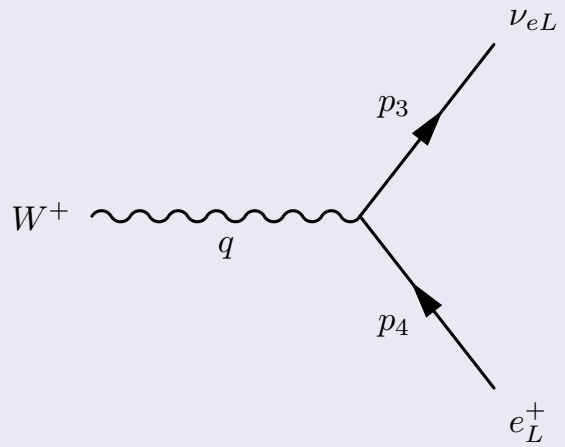
$$\Delta\mathcal{L} = \frac{g_W}{2\sqrt{2}} W_\mu^+ \left(\cos\theta_c \overline{\psi}_u \gamma^\mu (1-\gamma^5)\psi_d + \overline{\psi}_{\nu_e}\gamma^\mu(1-\gamma^5)\psi_e\right)$$

Production



- u PDF greater than $\bar{d}$
- on average $p_1 > p_2 \implies W^+$ prefers the p direction
- W^- prefers $\bar{p}$ direction

Decay

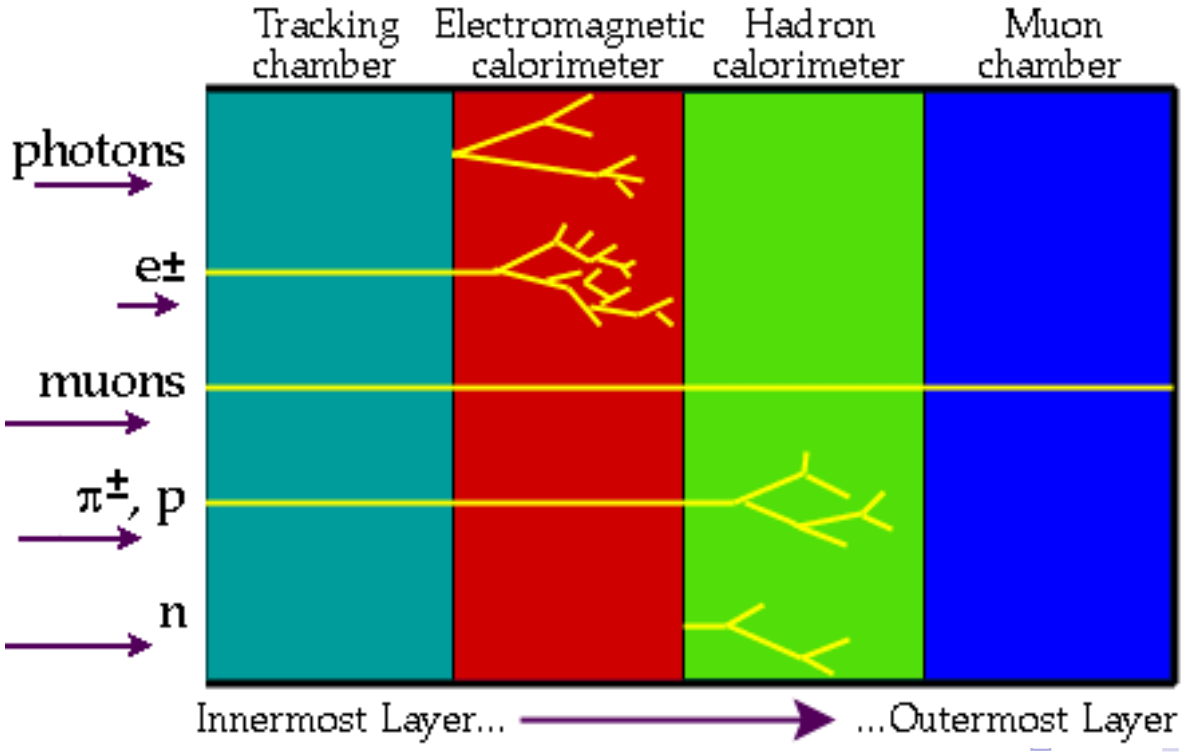


- $V-A$ decay $\implies$ XS $\propto (1+\cos\theta)^2$
- ν_e closer to W^+ direction
- e^- closer to W^- direction

(Pseudo-)rapidity distributions are **asymmetric**

How to discriminate real e from background?

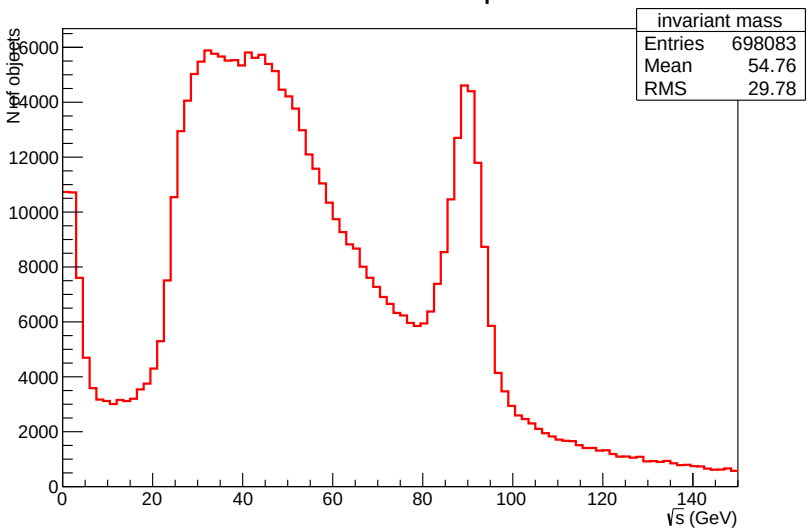
- $E_T > 25$ GeV, to stay away from jets
- Had/Em < 0.055 Hadron vs Em Calorimeter energy
- E_{iso}: energy within a $\eta - \phi$ cone (needs to be small)
- **Multiple e objects for the same event?**



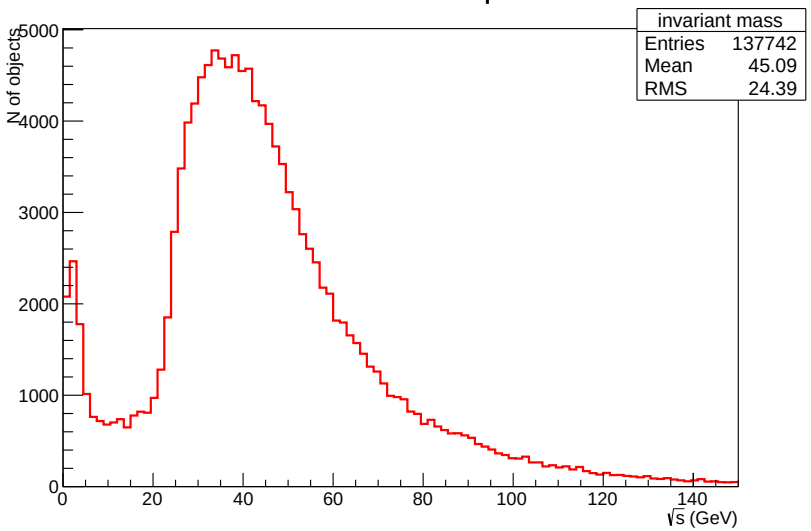
Conclusion of first part

- Some signal (E_T, $\not\!\!E_T$), but still too many events promoted
- Removed $Z \to e^+e^-$: cut on $2^{\text{nd}}/3^{\text{rd}}$ electron $E_T > 15$ GeV ✓

Before...

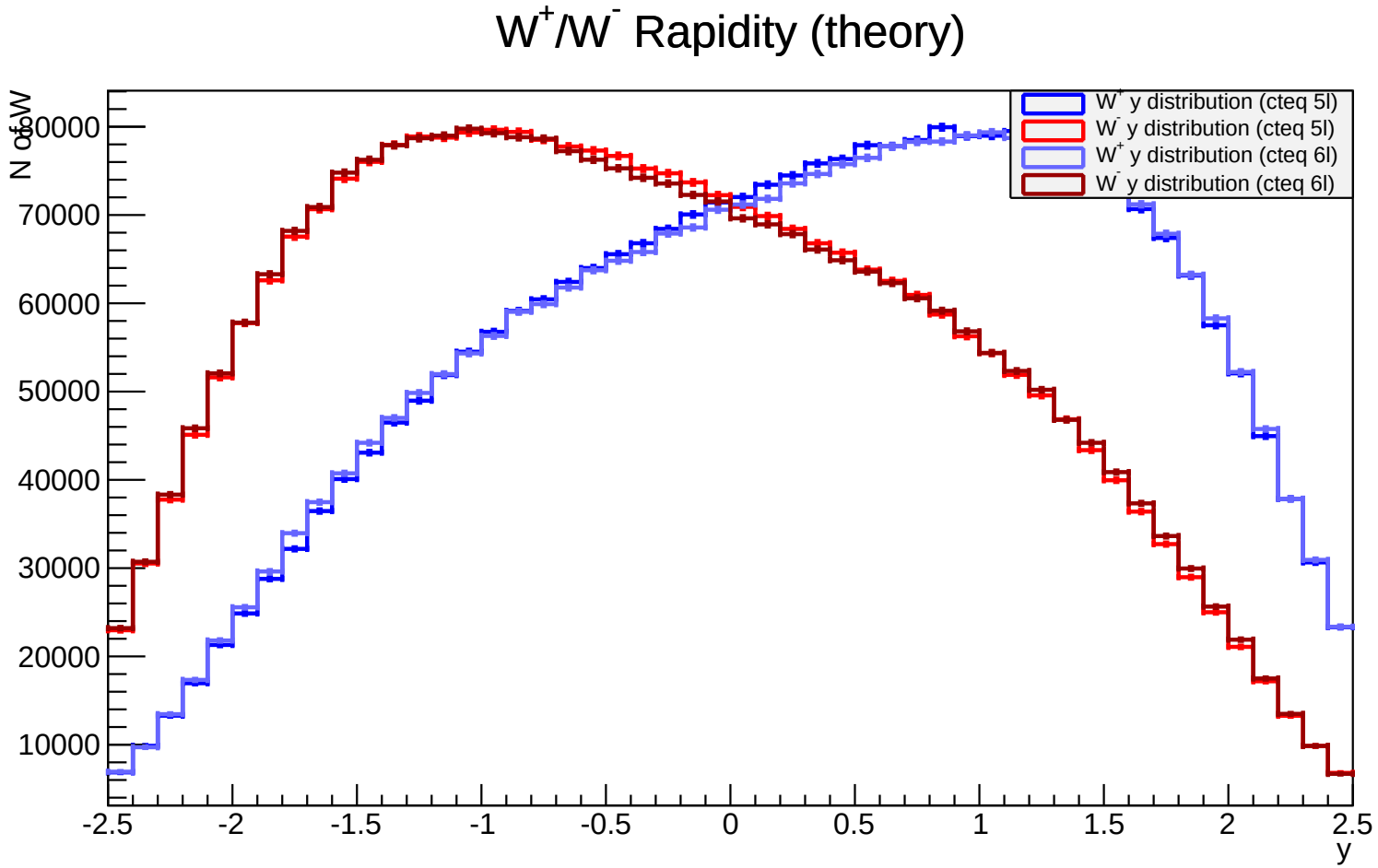


...After

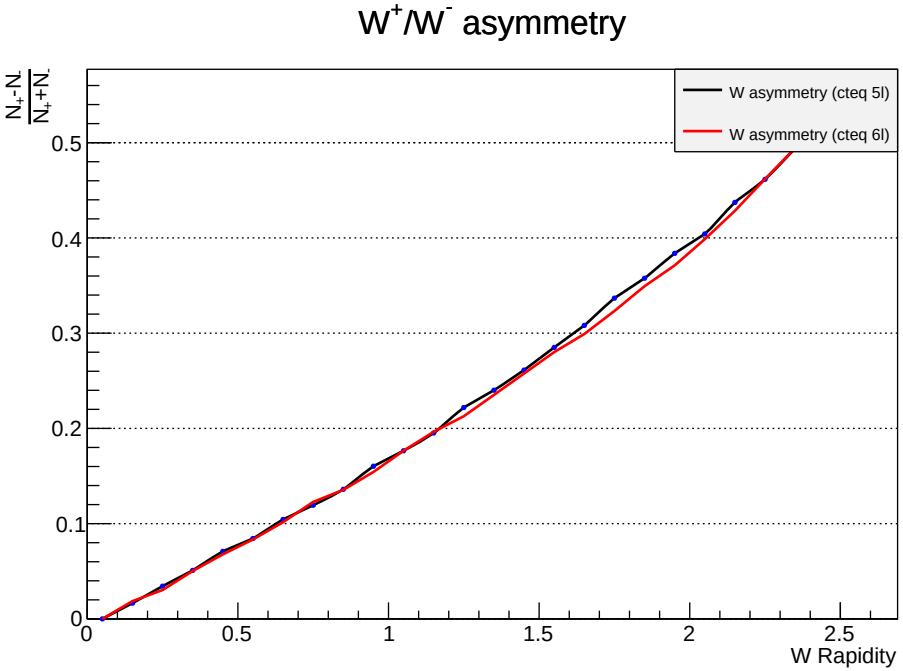


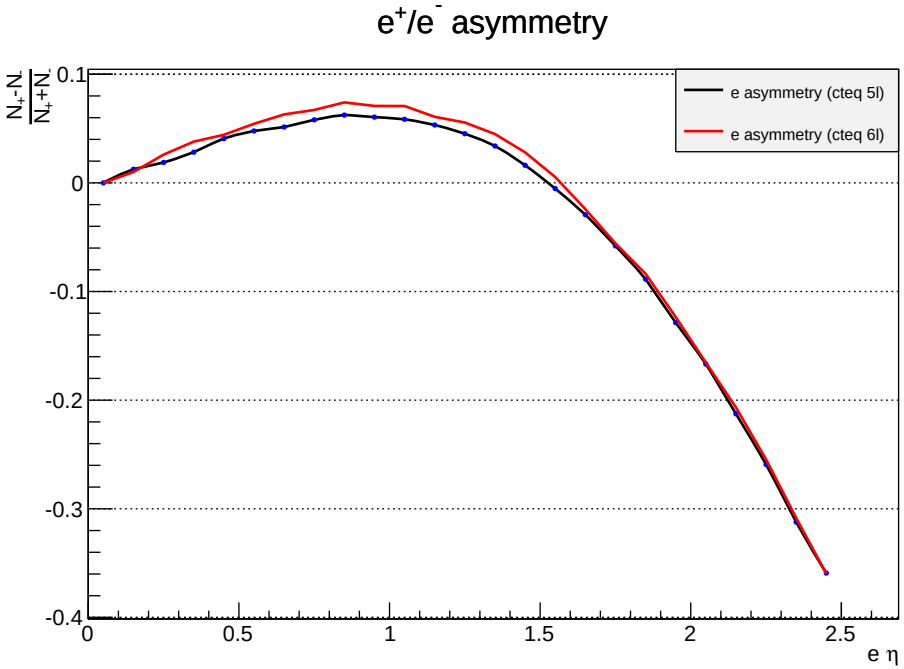
- Upgrade MC: new PDF set (cteq5l → cteq6l) ✓
- Additional cuts needed...

Theory expectations: cteq5l (1999) vs cteq6l (2002)



Theory expectations: cteq5l (1999) vs cteq6l (2002)





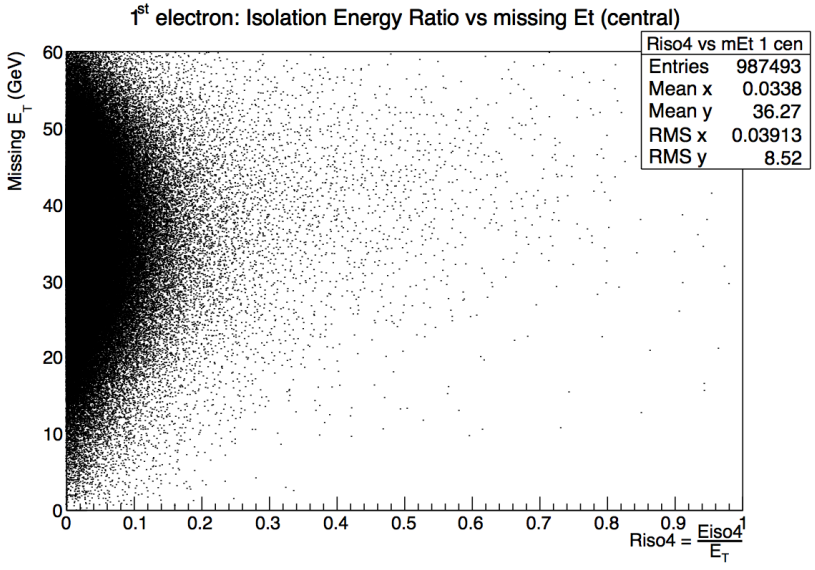
- cross check: the new CDF master script (almost) works
- no significant discrepancies, but some small differences due to **Run II data** in cteq6l

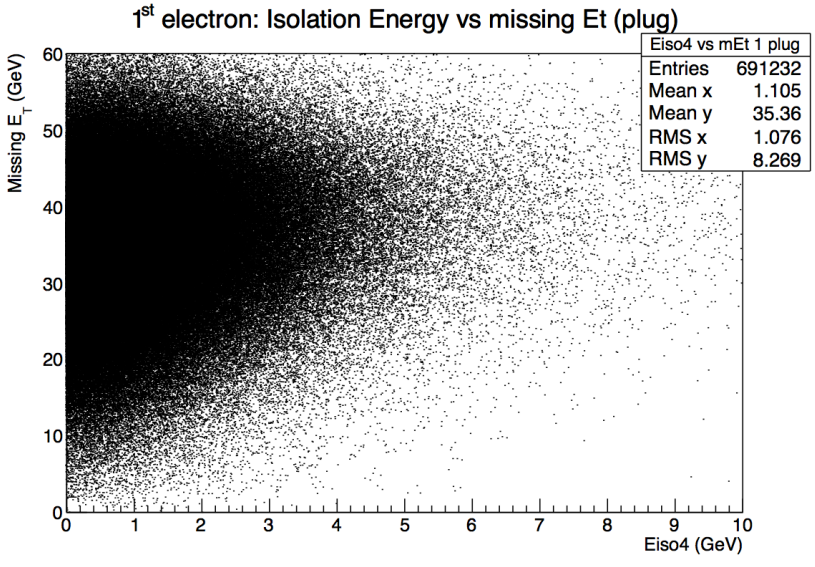
How to clean up the events

- Standard cuts (Had/Em, Tracker, E_T) ✓
- Select on events with only one electron candidate
- Cutting on $\not\!\!E_T$: previous CDF measurements were inconsistent
- CMS analysis (A.Khukhunaishvili) new method: cutting only on **isolation energy**
- The CMS analysis was on μ^+, μ^-
- Can we apply the same method at CDF?
- Scatter plots of isolation energy vs $\not\!\!E_T$
- $\not\!\!E_T > 23$ GeV for central and $\not\!\!E_T > 30$ GeV for plug
- $R_{\text{iso}} < 0.25$ for central and $E_{\text{iso}} < 4$ GeV for plug

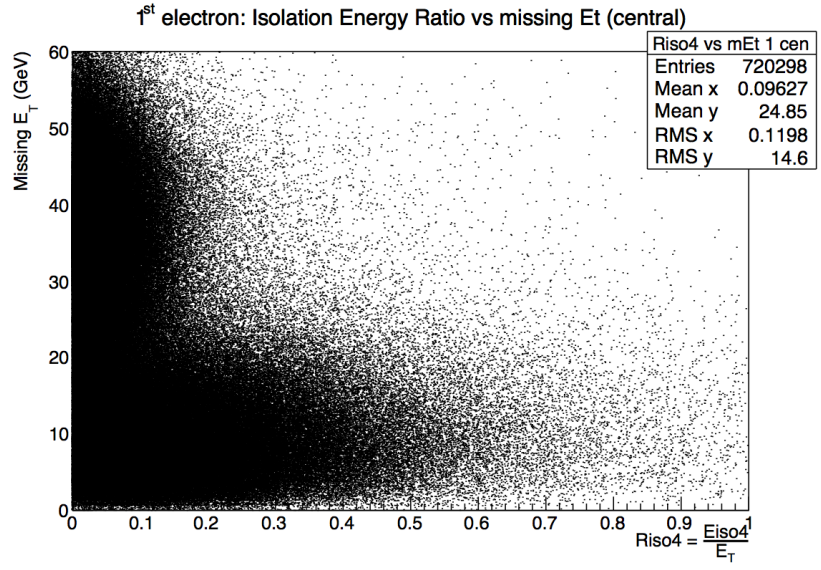
Scatter plots: E_{iso} vs $\not\!\!E_T$ before cuts

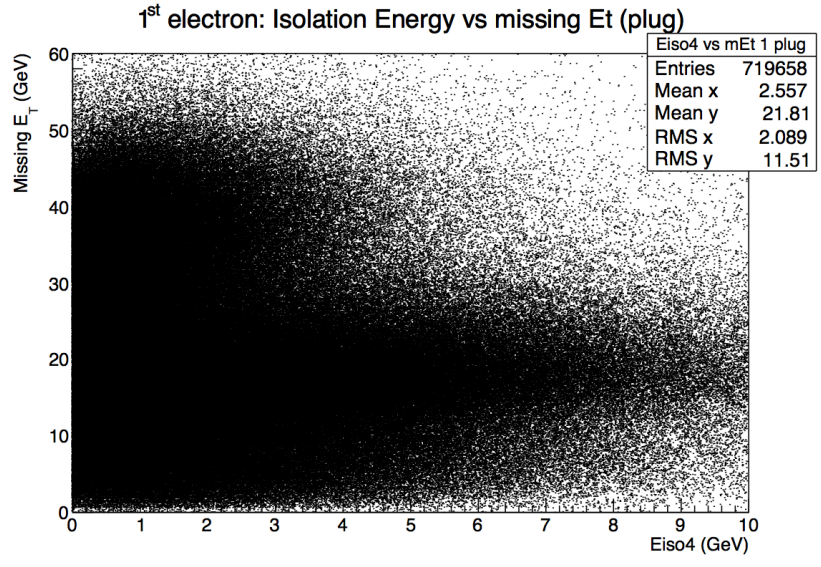
SIMULATION





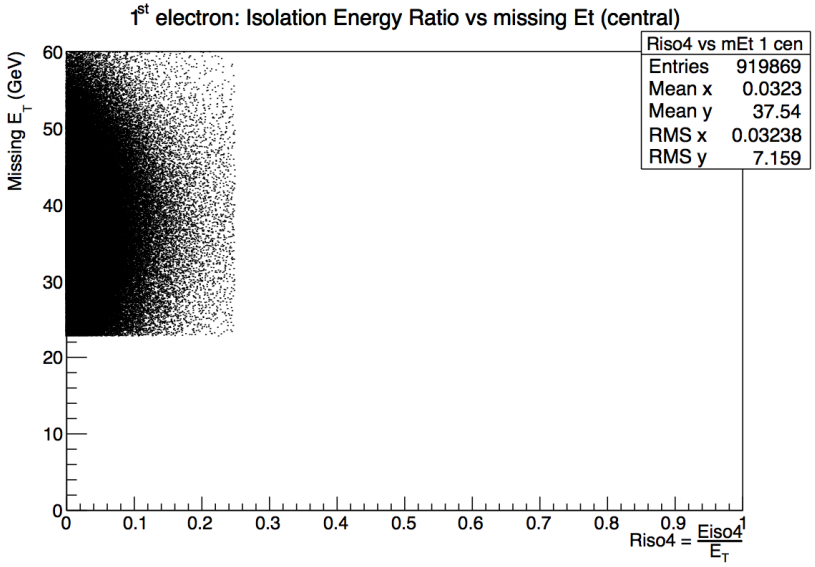
DATA

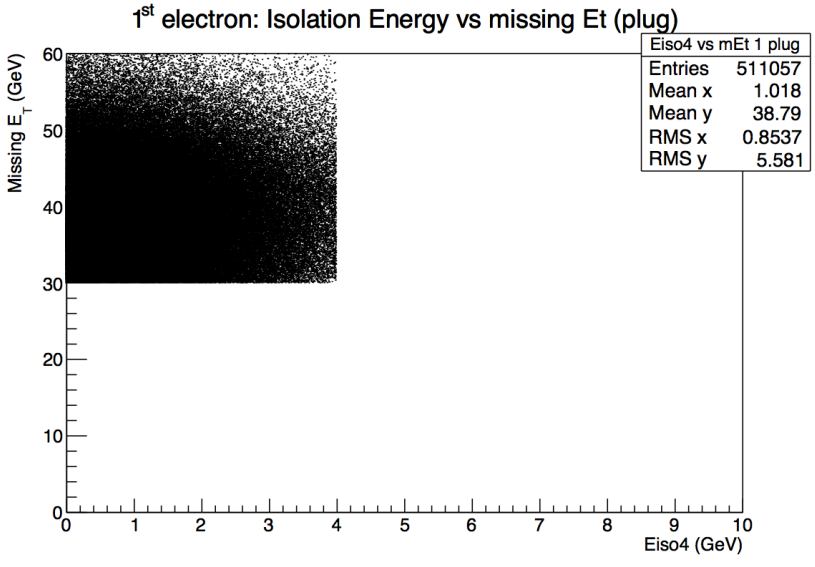




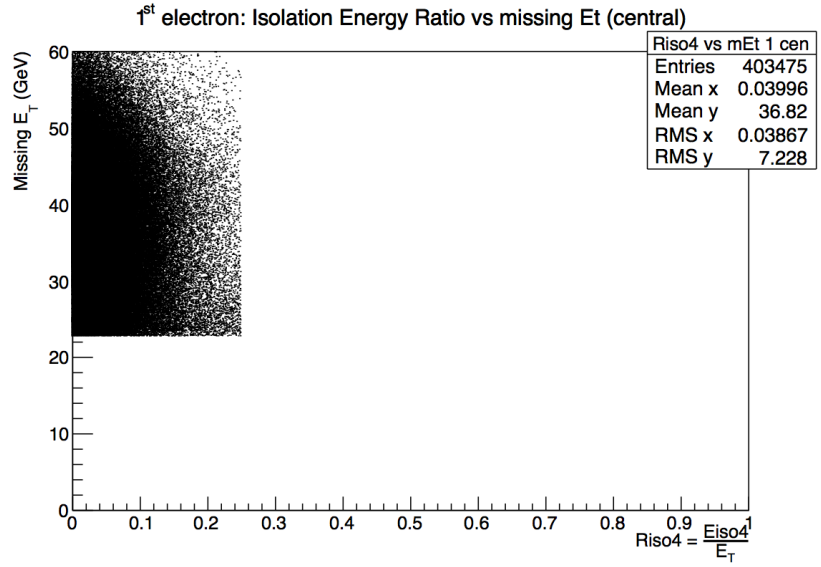
Scatter plots: E_{iso} vs $\not\!\!E_T$ after cuts

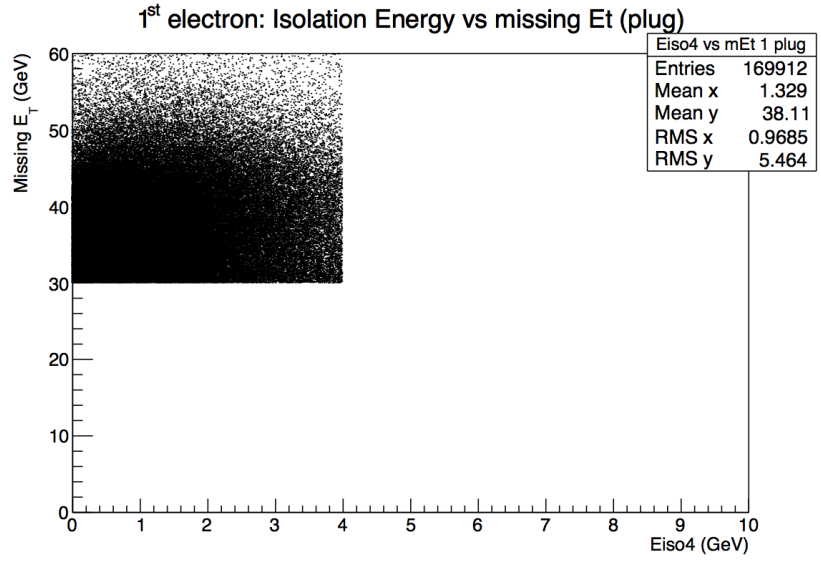
SIMULATION





DATA

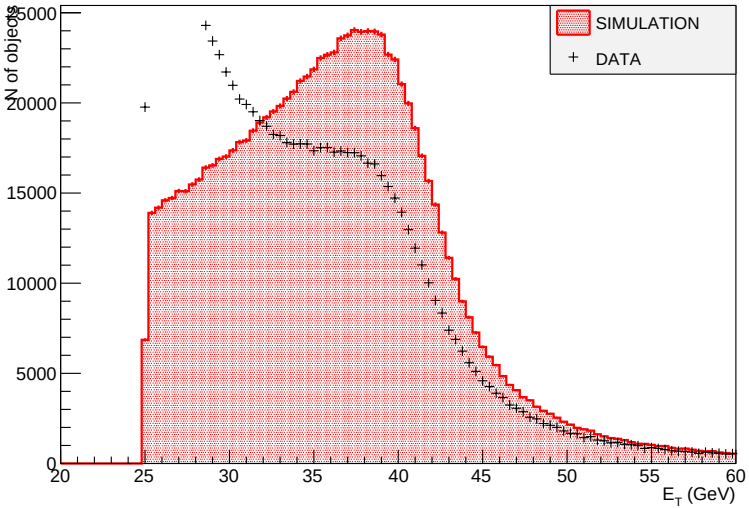




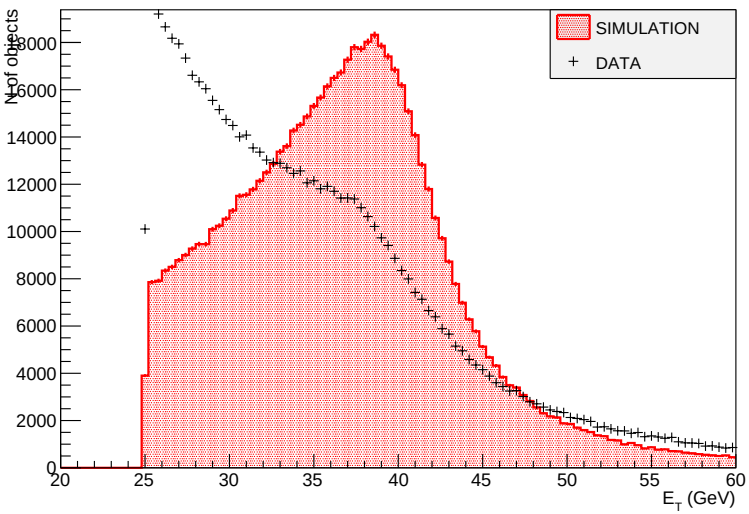
E_T: before and after cuts

BEFORE

E_T of 1st electron (cen) Before Cuts

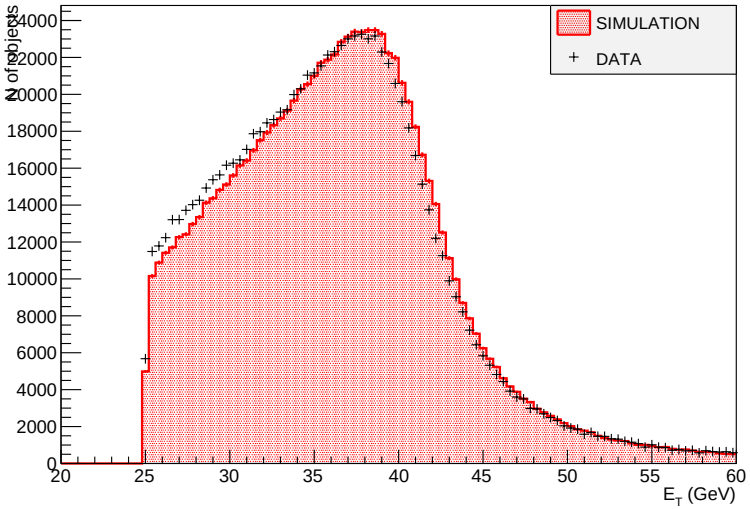


E_T of 1st electron (plug) Before Cuts

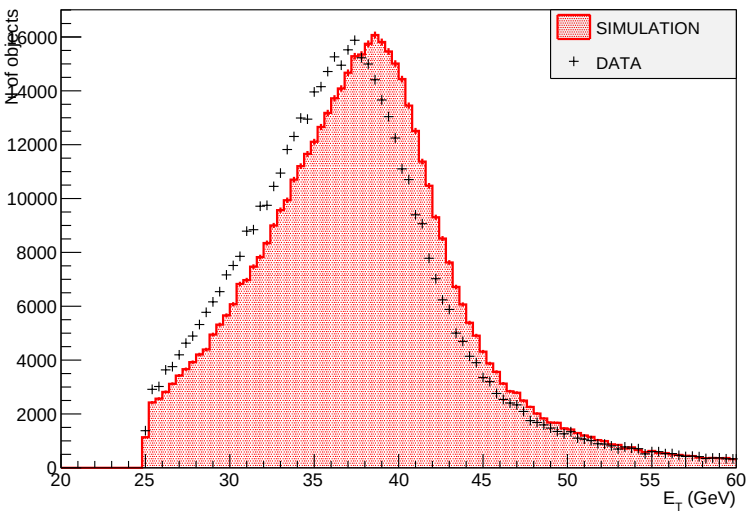


AFTER

E_T of 1st electron (cen) After Cuts



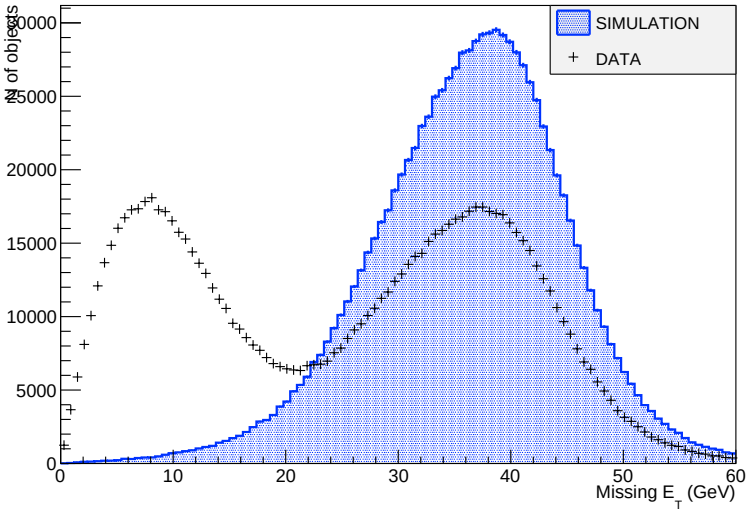
E_T of 1st electron (plug) After Cuts



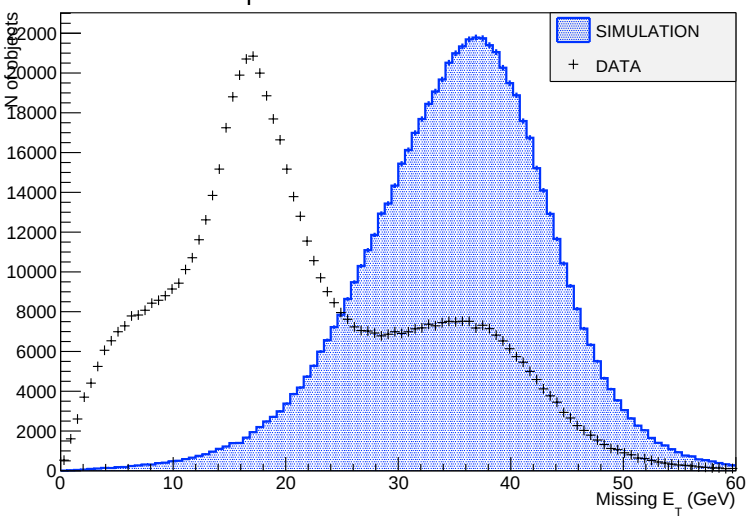
$\not\!\!E_T$: before and after cuts

BEFORE

Missing E_T of 1st electron (cen) Before Cuts

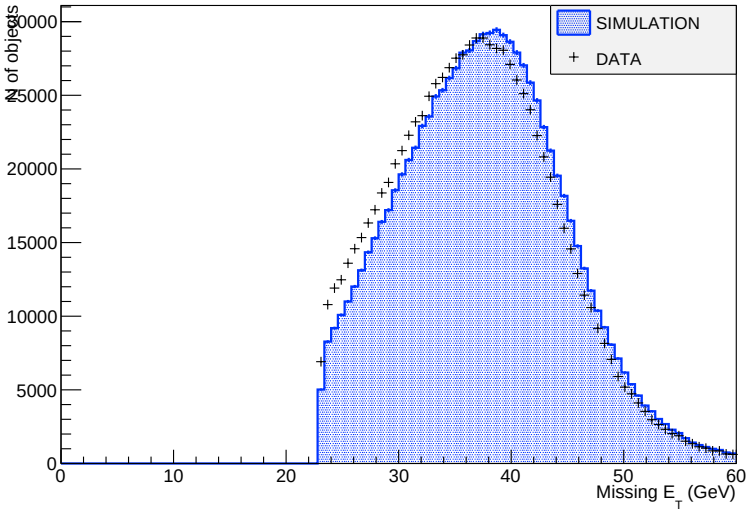


Missing E_T of 1st electron (plug) Before Cuts

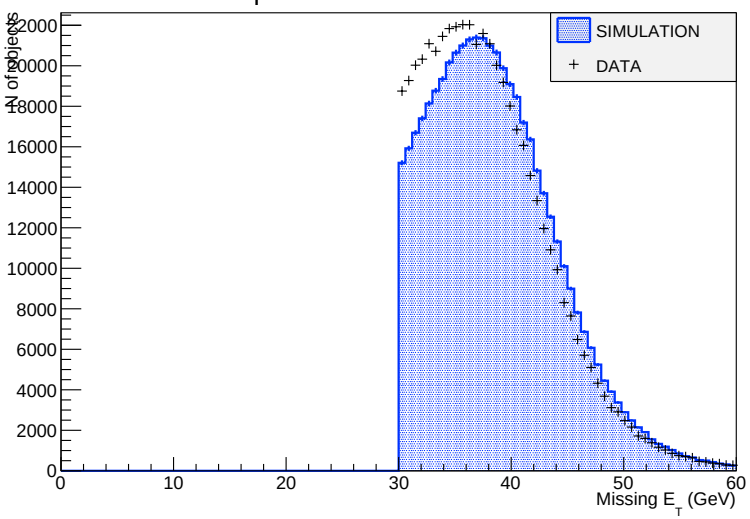


AFTER

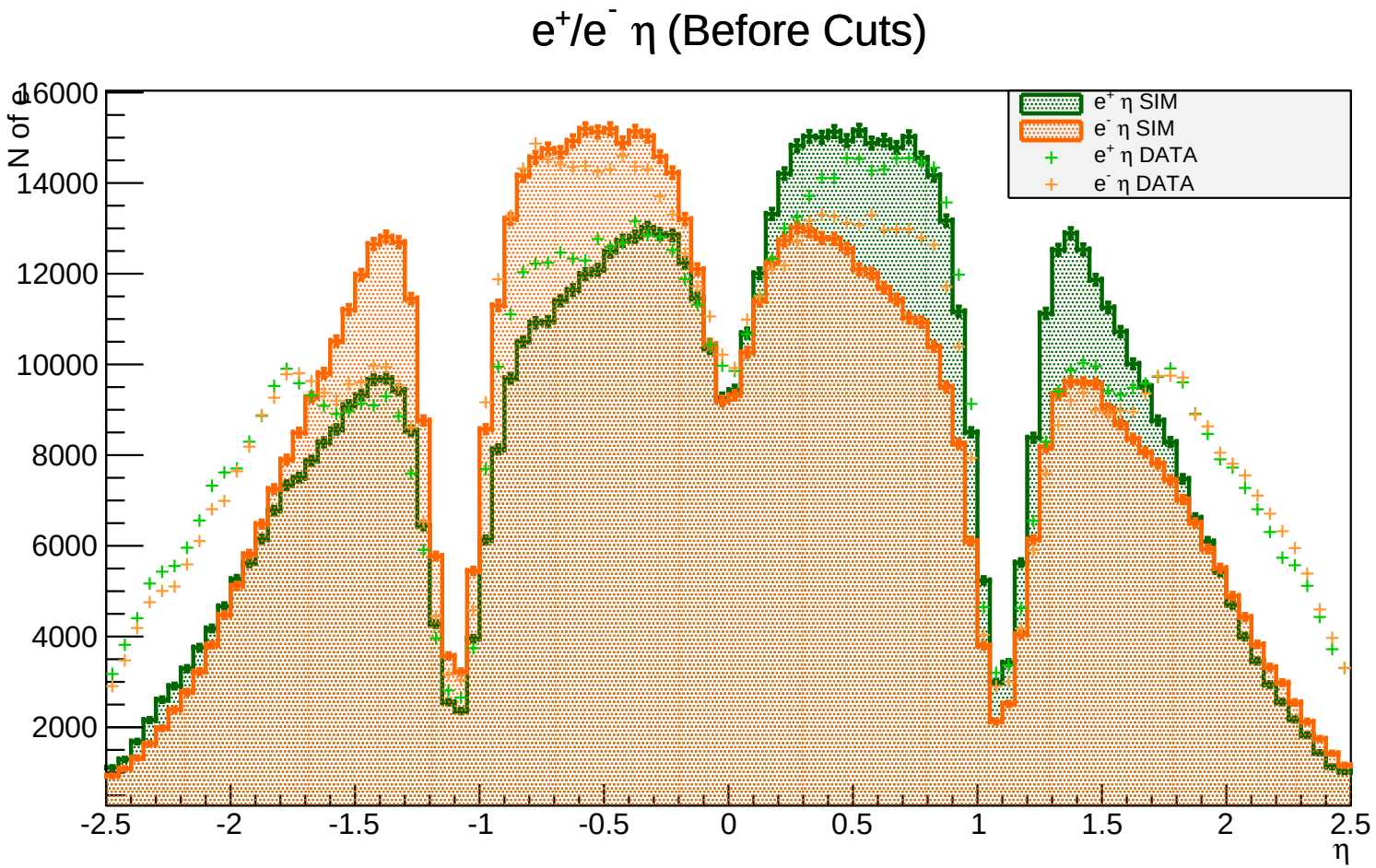
Missing E_T of 1st electron (cen) After Cuts



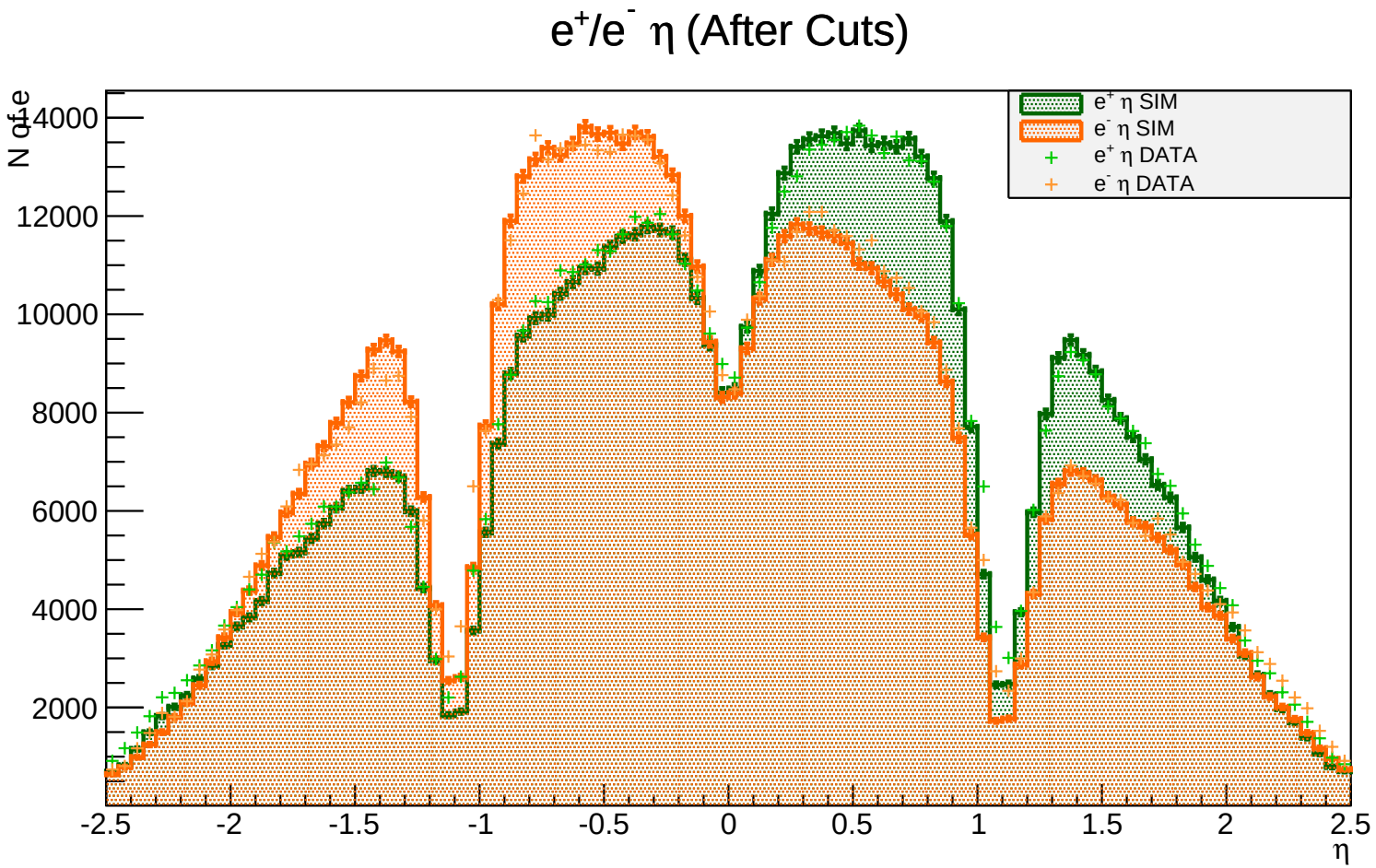
Missing E_T of 1st electron (plug) After Cuts



η plots: BEFORE CUTS...



η plots: ...and AFTER CUTS



Concluding remarks

What we've understood

- **cteq6l** PDF set shows no significant discrepancy but is an improvement
- we got the master script (MC+Ntupler) to work
- it is not possible to perform the analysis with muons
- it is not possible to only select on E_{iso} (parallel $\not\!\!E_T$ cut is necessary)
- scatter plots let us know how hard we need to cut

What is left to do

- submit the whole **CDF Run II** dataset with the master script
- babysit the job on the grid
- strip classes and plot macros are ready to use ✓