Trilepton Analysis: The WH $\rightarrow$ WWW $\rightarrow l\nu l\nu l\nu$ Signal

Double-Counted Electrons and PHX Electrons

Jason Nett

University of Wisconsin - Madison

Collider Detector at Fermilab

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Summary

Electrons as Stubless Muons

- Recall: Some electrons are double-counted as stubless muons.
- P_T values may differ, but η and ϕ remain the same.
- 1st: Observe ΔR between stubless muons and closest electrons by:
  - stubless muons that are muon-like
  - stubless muons that are electron-like
- 2nd: Choose ΔR that separates them.

ΔR between stubless muons and electrons

ΔR of stubless muons that appear to be electron-like according to:

- $\frac{\text{HadE}}{\text{EmE}} < 0.06$
- $\frac{\text{Em. Energy}}{P} < 2.5$

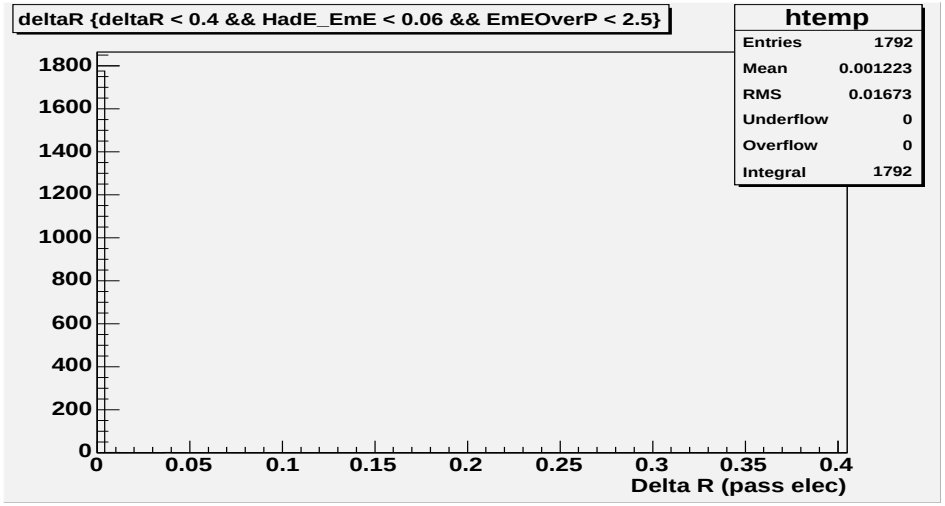

Figure: ΔR for stubless muon objects passing the electron ID cuts above.

ΔR between stubless muons and electrons

ΔR of stubless muons that appear to be muon-like according to:

- Em. Energy $<$ 2.0 GeV
- Had. Energy $<$ 6.0 GeV

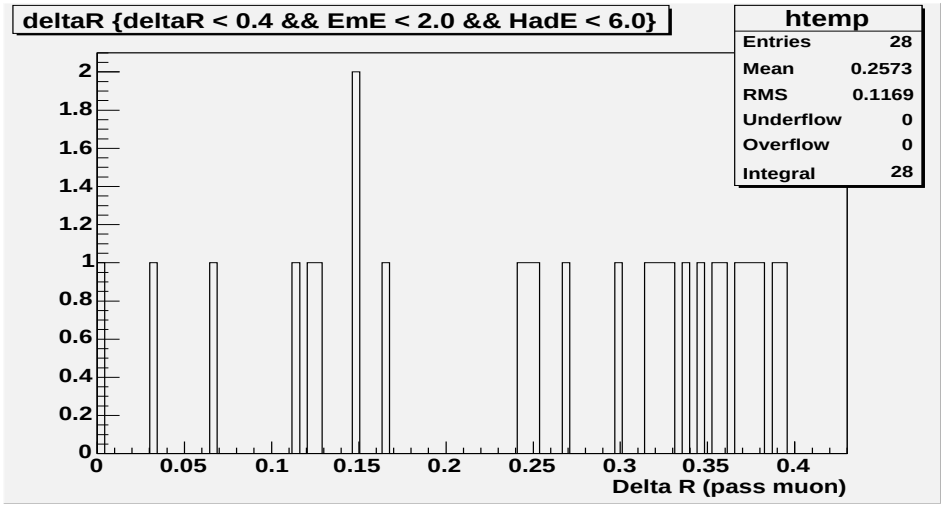

Figure: ΔR for stubless muon objects passing the muon ID cuts above (within *DeltaR* $<$ 0.4.

Conclusion/Old Result Table

So choosing to cut out stubless muons within $DeltaR < 0.001$ appears to be an appropriate method to remove double-counted electrons from the muon list. Old result table:

Cuts	Number (out of 100,000)	%(from previous step)
Pass $HW \rightarrow WWW \rightarrow l\nu l\nu l\nu$ filter	2358	2.36
P_T , η cuts at generator-level	1902	80.6
Lead, 2nd, 3rd Reconstructed leptons found	1725	90.7
Same P_T , η cuts at reconstruction-level	1597	92.6
Pass Matching Criterion	1493	93.5
Pass Quality/Isolation Cuts	1368	91.6

Table: Old Event Summary which included double counted leptons. Often, the same lepton would show up among the leading three leptons twice, once as an electron and once as a muon.

New Result Table: Double-counted Electrons Removed

Cuts	Number (out of 100,000)	%(from previous step)
Pass $HW \rightarrow WWW \rightarrow l\nu l\nu l\nu$ filter	2358	2.36
P_T , η cuts at generator-level	1902	80.6
Lead, 2nd, 3rd Reconstructed leptons found	1725	97.0
Same P_T , η cuts at reconstruction-level	1597	92.2
Pass Matching Criterion	1041	93.8
Pass Quality/Isolation Cuts	848	85.7

Table: New Event Summary. Notice that after quality/isolation cuts are imposed in the last step that we are left with 65 more events than when stubless muons are restricted to match to only generator-level muons.

PHX Electrons Defined

- Stntuple: Every EM Cluster/track combination found using PHX algorithm is labeled as `isPhoenix` by Stntuple. Up to user to choose analysis-specific cuts.
- Dbntuple: Begins with Stntuple, but does not use `isPhoenix` label. Defined:
  - `isPlug == true`
  - $\frac{\text{Had. E}}{\text{Em. E}} < 0.05$
  - $1.2 < |\text{pesEta}| < 2.0$
  - $\texttt{CalIso} = \frac{\text{Iso} - \text{LeakCorr} \cdot E_T}{E_T} < 0.1$
  - $\texttt{PesPemDeltaR} < 3.0$
  - $\texttt{Pes5x9(0)} > 0.65$
  - $\texttt{Pes5x9(1)} > 0.65$
  - $\texttt{Pem3x3FitTower} > 1$
  - $\texttt{PemChi2Three} < 10.0$
  - $-60.0 < \text{z0} < 60.0$
  - $\text{NSvxHits} \geq 3$

Do These Definitions Agree?

PHX Defn.	1st lepton	2nd lepton	3rd lepton
Stntuple's `isPhoenix`	67	76	59
Dbntuple's PHX defn. in my ntuple	42	40	33
Overlap of both	37	37	28

Table: Event Summary: The Stntuple count is restricted to electrons labeled as `isPhoenix` within $1.2 < |\eta| < 2.0$