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

Mismatched Muons and New Results

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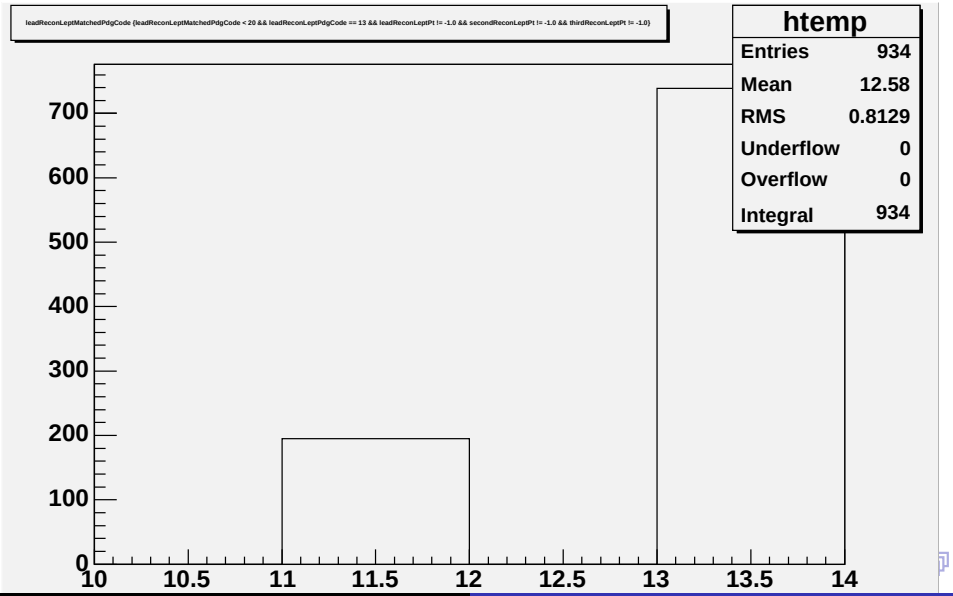
Summary

Questions From Last Week

- Why are so many muons matching to electrons?
- Why does the matching requirement cut out so many events?
- If we allow matching to any charged particle, why do quality cuts still bring the event count down to roughly the same either way?



Last Week's Summary

Cuts	Number (out of 100,000)	%(from previous step)
Pass $HW \longrightarrow WWW \longrightarrow l\nu l\nu l\nu$ filter	2358	2.36
P_T , η cuts at generator-level	1902	80.6
Lead, 2nd, 3rd Reconstructed leptons found	1845	97.0
Same P_T , η cuts at reconstruction-level	1702	92.2
Pass Matching Criterion	1129	66.3
Pass Quality/Isolation Cuts	771	68.3

Table: Event Summary

Electrons Reconstructed as Muons

Matches(%)	electrons	muons	pions	kaons	protons	Total
Lead stubbed muons	0	634(100%)	0	0	0	634
Lead CMIO muons	195(64.4%)	105(34.6%)	2(0.7%)	0	1(0.3%)	303
2nd stubbed muons	2(0.5%)	435(99.5%)	0	0	0	437
2nd CMIO muons	550(85.1%)	91(14.1%)	5(0.8%)	0	0	646
3rd stubbed muons	1(0.2%)	505(99.6%)	1(0.2%)	0	0	507
3rd CMIO muons	483(78.9%)	108(17.6%)	17(2.7%)	0	4(0.6%)	612
lead electrons	681(99.4%)	3(0.4%)	1(0.1%)	0	0	685
2nd electrons	529(98.1%)	4(0.7%)	5(0.9%)	1(0.2%)	0	539
3rd electrons	485(98.2%)	2(0.4%)	5(1.0%)	2(0.4%)	0	494

Table: Separately considering stubbed-muons and stubbless-muons, it is the stubbless muons that match to electrons.

Stubbed vs. CMIO Muons

- Muons matching to electrons: No other nearby muon objects.
- Separately plotting Em. Energy for stubbed and stubbless muons: stubbless muons look like electrons.
- The electron-like Em. Energy distribution for stubbless muons explains why quality cuts were found to remove the mismatches. Muons required Em. Energy < 2.0 GeV.

Leading Leptons: Stubbed-Muons

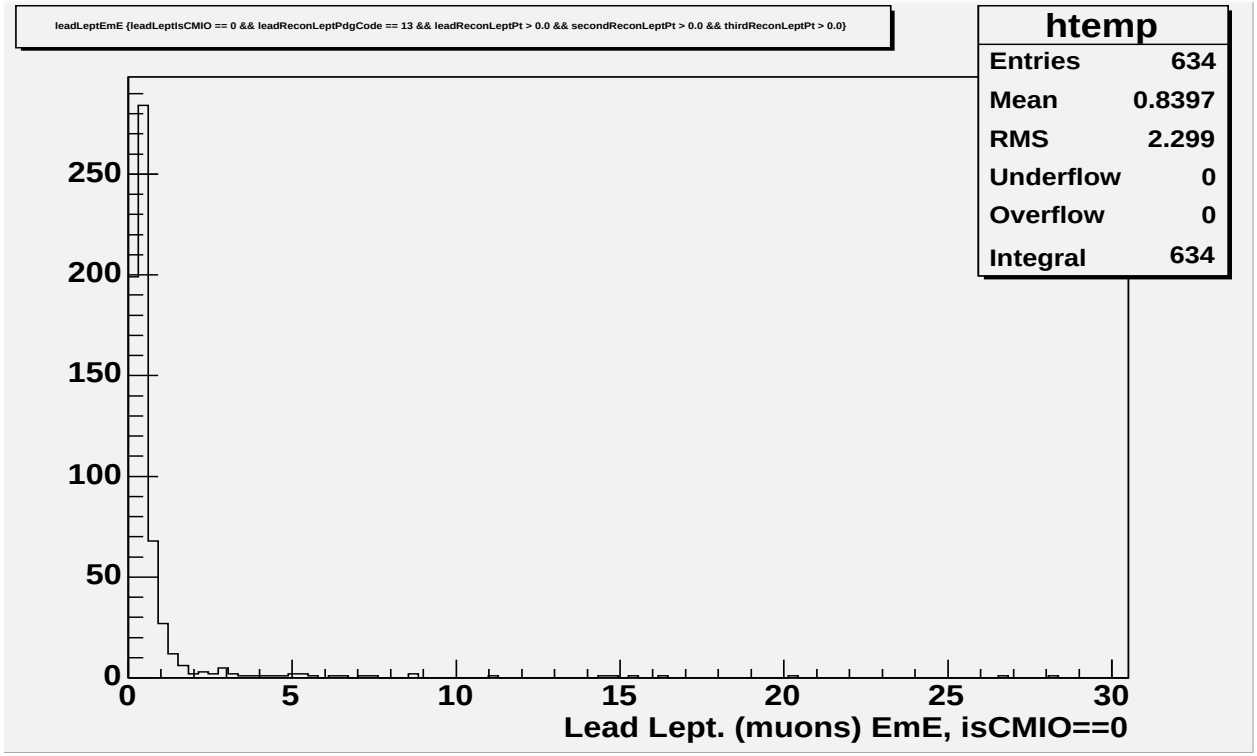


Figure: Electromagnetic energy for leading muon objects that do have stubs. Quality Cut for electomagnetic energy is EmE < 2.0.

Leading Leptons: CMIO Muons

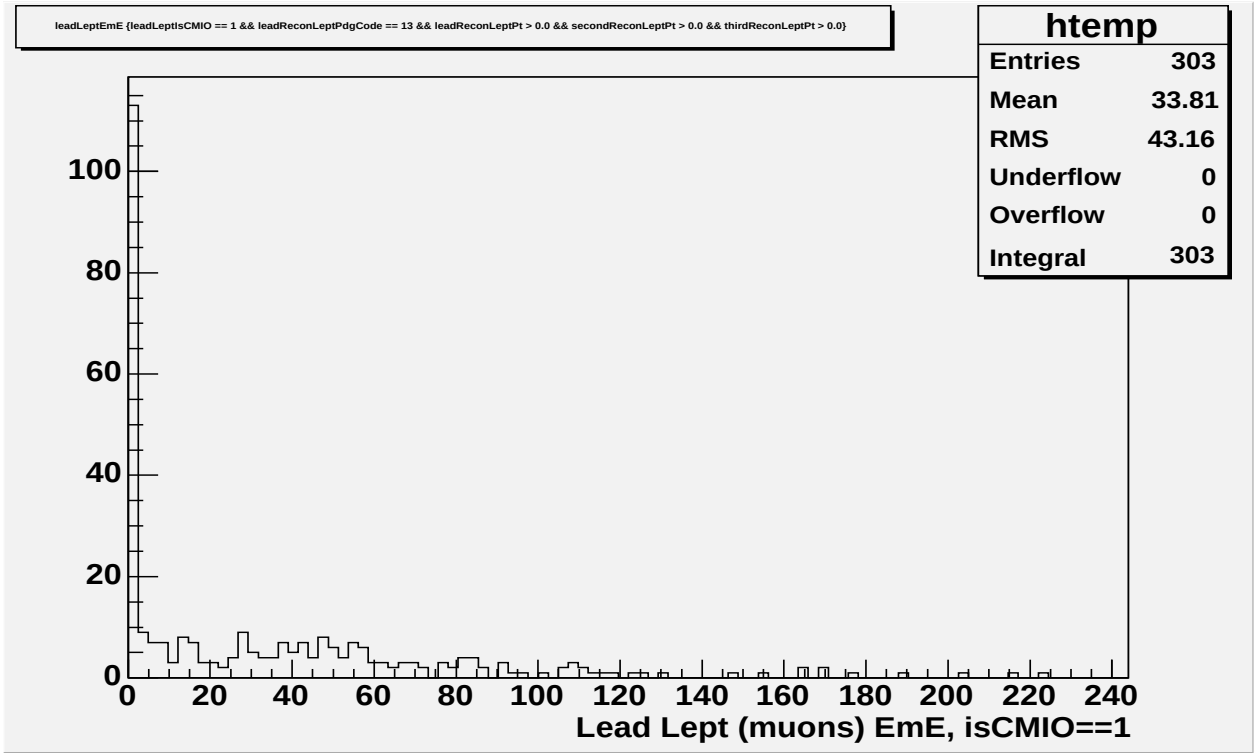


Figure: Electromagnetic energy for leading muon objects that do not have stubs. Quality Cut for electomagnetic energy is EmE $<$ 2.0.

2nd Leptons: Stubbed-Muons

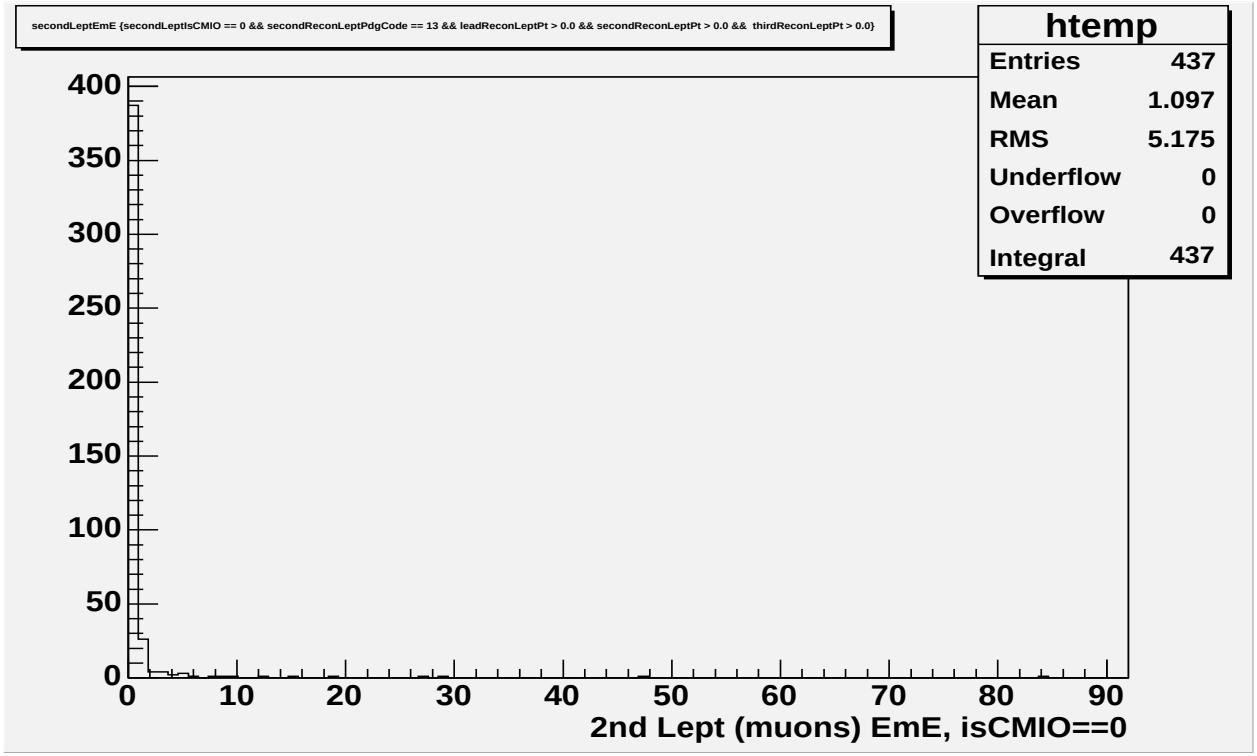


Figure: Electromagnetic energy for 2nd muon objects that do have stubs. Quality Cut for electomagnetic energy is EmE $<$ 2.0.

2nd Leptons: CMIO Muons

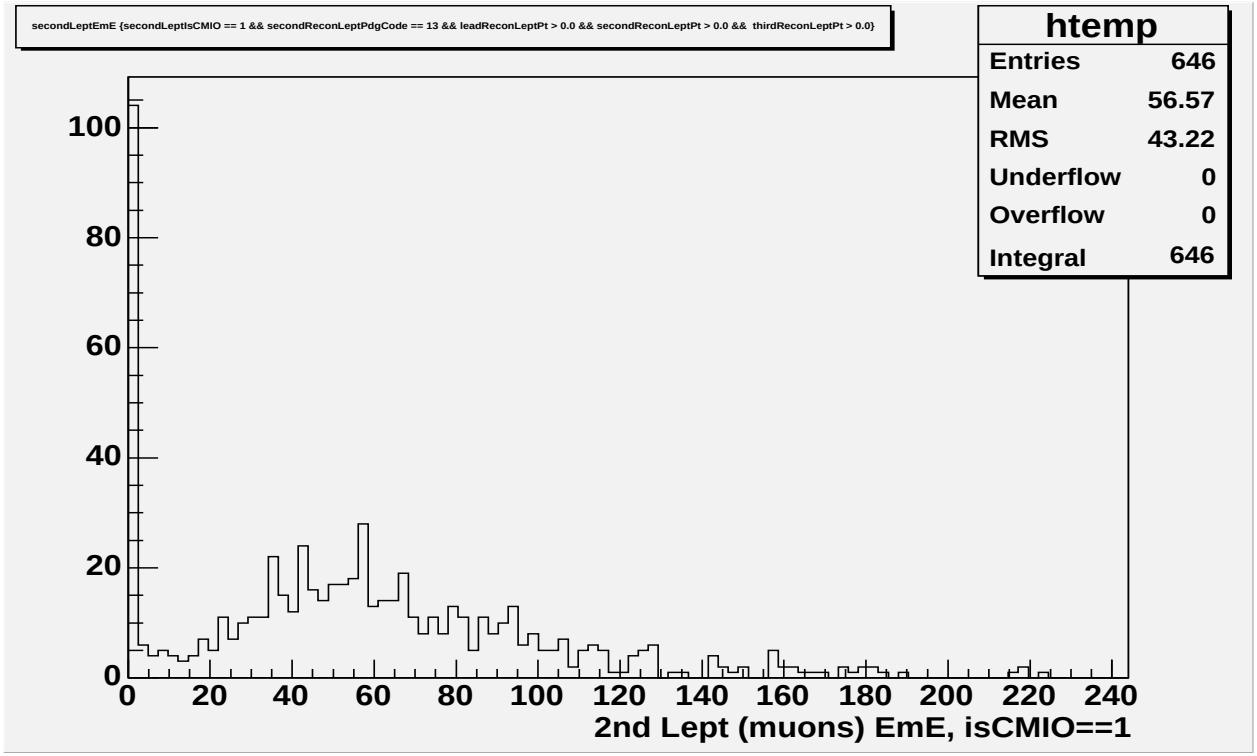


Figure: Electromagnetic energy for 2nd muon objects that do not have stubs. Quality Cut for electomagnetic energy is EmE < 2.0.

3rd Leptons: Stubbed-Muons

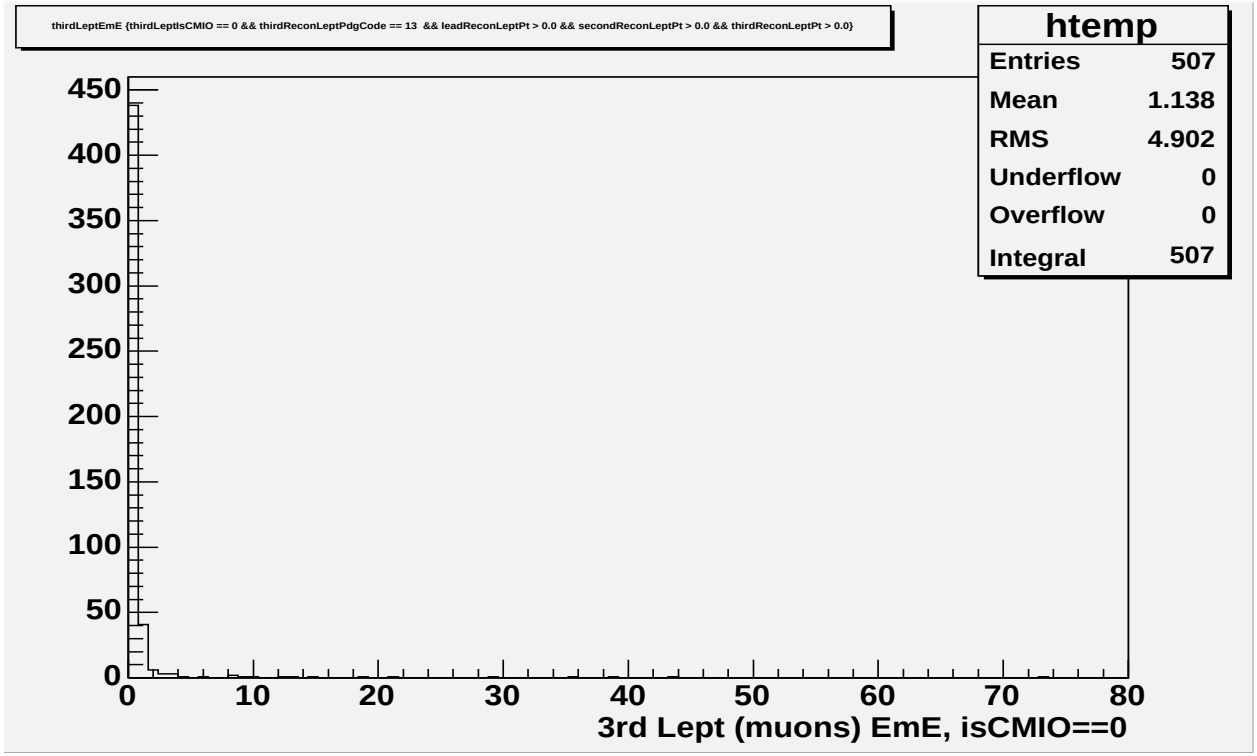


Figure: Electromagnetic energy for 3rd muon objects that do have stubs. Quality Cut for electomagnetic energy is EmE $<$ 2.0.

3rd Leptons: CMIO-Muons

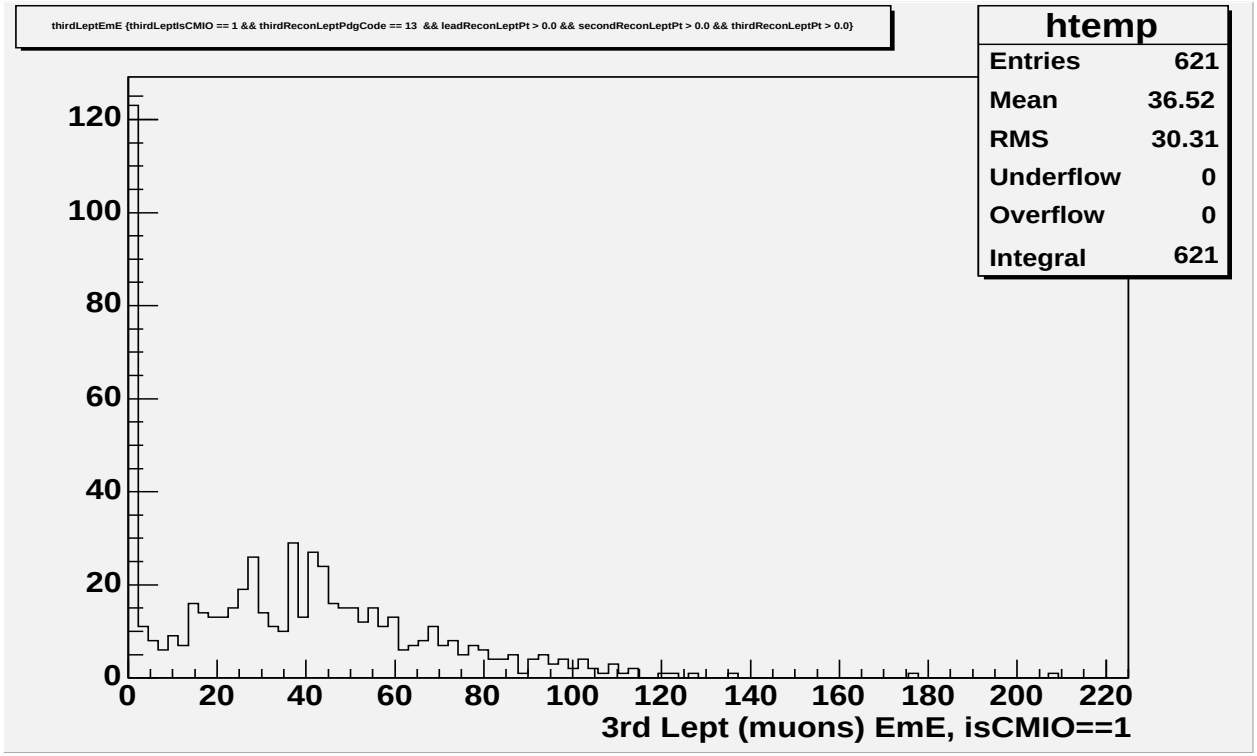


Figure: Electromagnetic energy for 3rd muon objects that do not have stubs. Quality Cut for electomagnetic energy is EmE $<$ 2.0.

Changes to Matching And Quality Cuts

- For Matching, now allow:
  - Electrons only search for matches among electrons
  - Stubbed-Muons only search for matches among muons
  - CMIO-Muons search for matches among both electrons and muons
- Previously required of all muons: Em. E $<$ 2.0; Had. E $<$ 6.0; TrackIso/P_T $<$ 0.1
- Now require these three cuts of only stubbed-muons, only isolation cut of CMIO muons.

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Same P_T , η cuts at reconstruction-level	1702	92.2
Pass Matching Criterion	1596	93.8
Pass Quality/Isolation Cuts	1368	85.7

Table: Event Summary