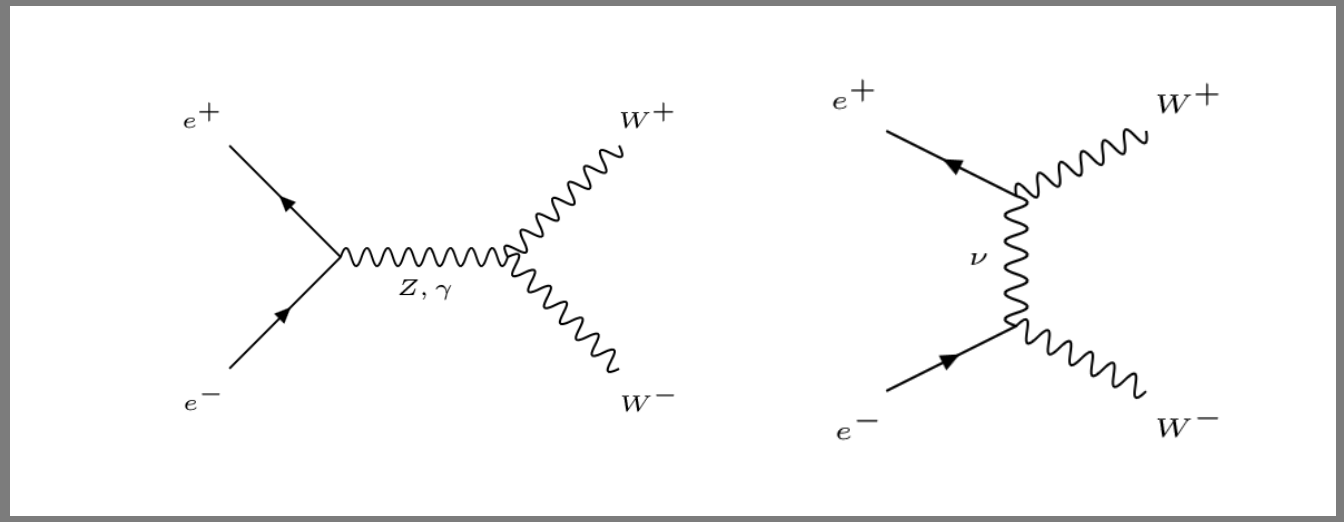
WW Analysis using semileptonic decay channel

Justin Anguiano

Introduction



Perform Benchmark study by obtaining physics observables:

- Dynamics associated with TGC from W^- production angle
- m_W measured from qq jets
- Measurement of the beam polarization through WW cross section

- WW $\rightarrow qq\ l\nu$ semileptonic decay with $l = \mu, \tau$
- Initially use polarizations (e_L^-, e_R^+) (e_R^-, e_L^+)

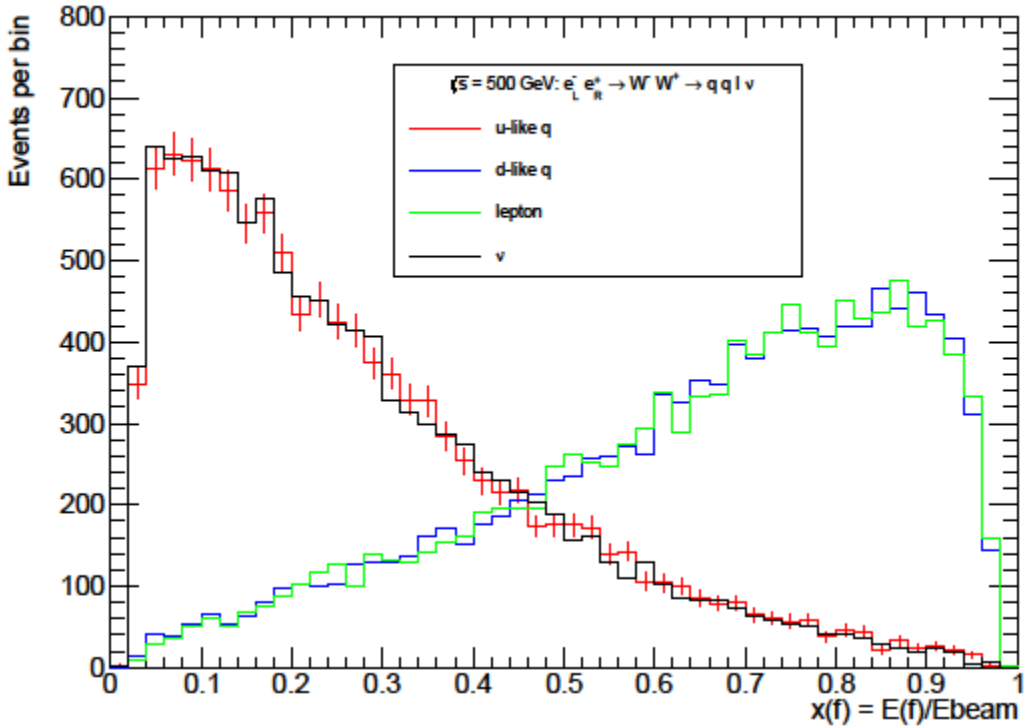
- Using standard signal samples:

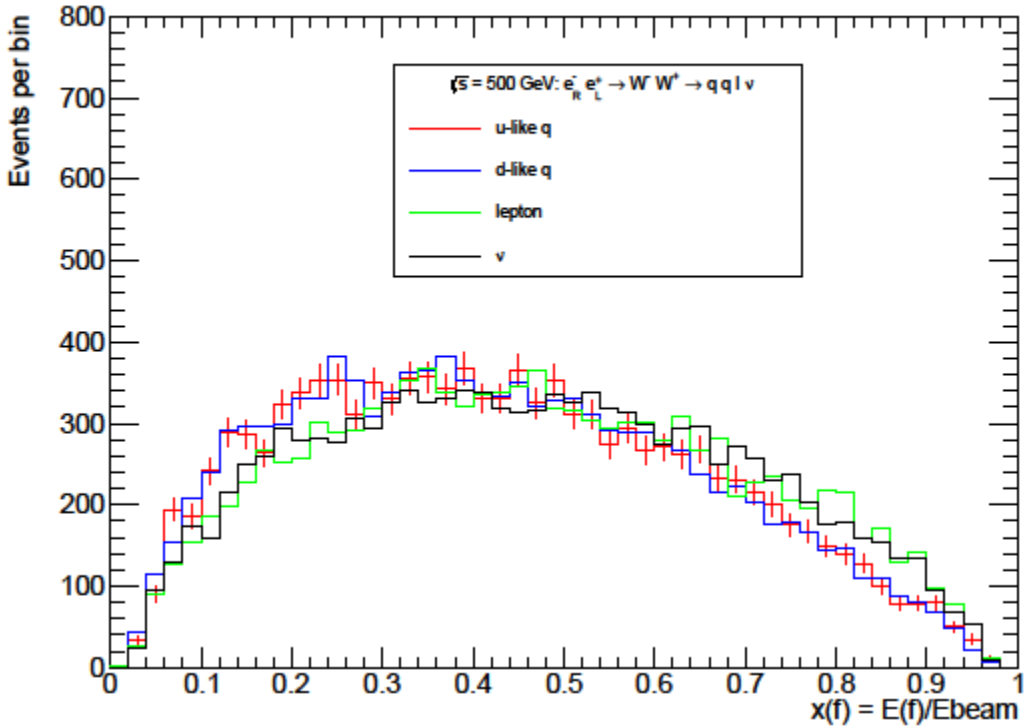
rv02-00-01.sv02-00-01.mILD_l5_o1_v02.E500-TDR_ws.I250018.P4f_ww_sl.eL.pR.n001.d_dstm_10318_0.slcio

  - Running on v2-00-02
  - Currently only addressing large detector

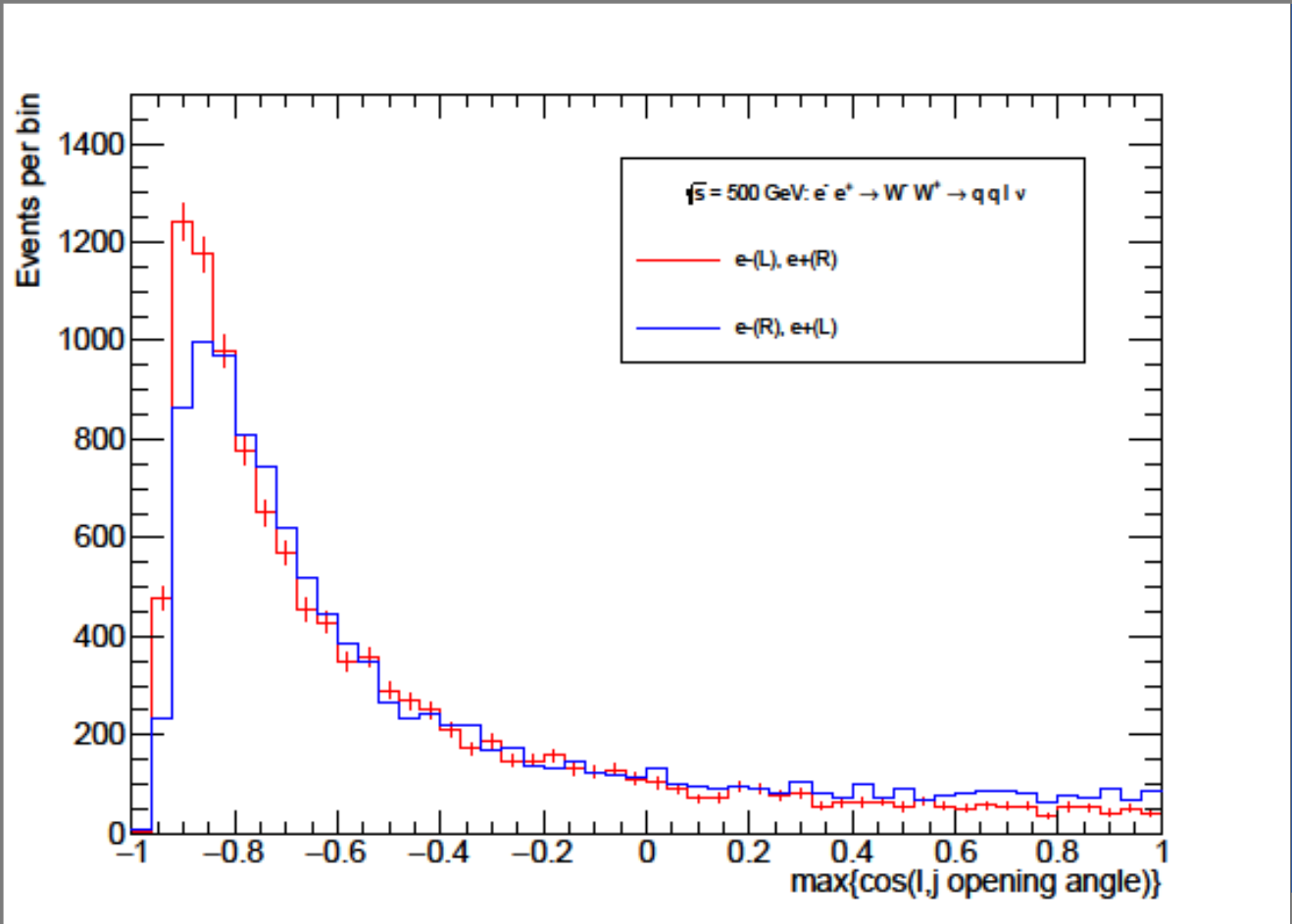
Decay Characteristics

- First Look at the rescaled energies of the 4 fermions
- Energy Partitioning is completely different for mirrored polarizations





Decay Characteristics

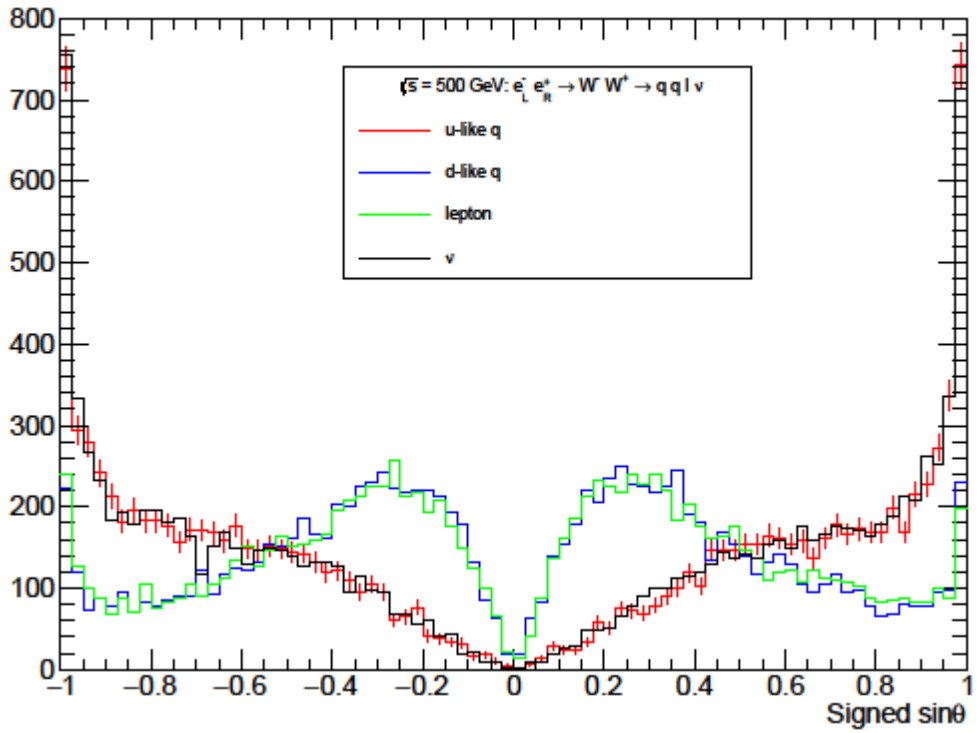


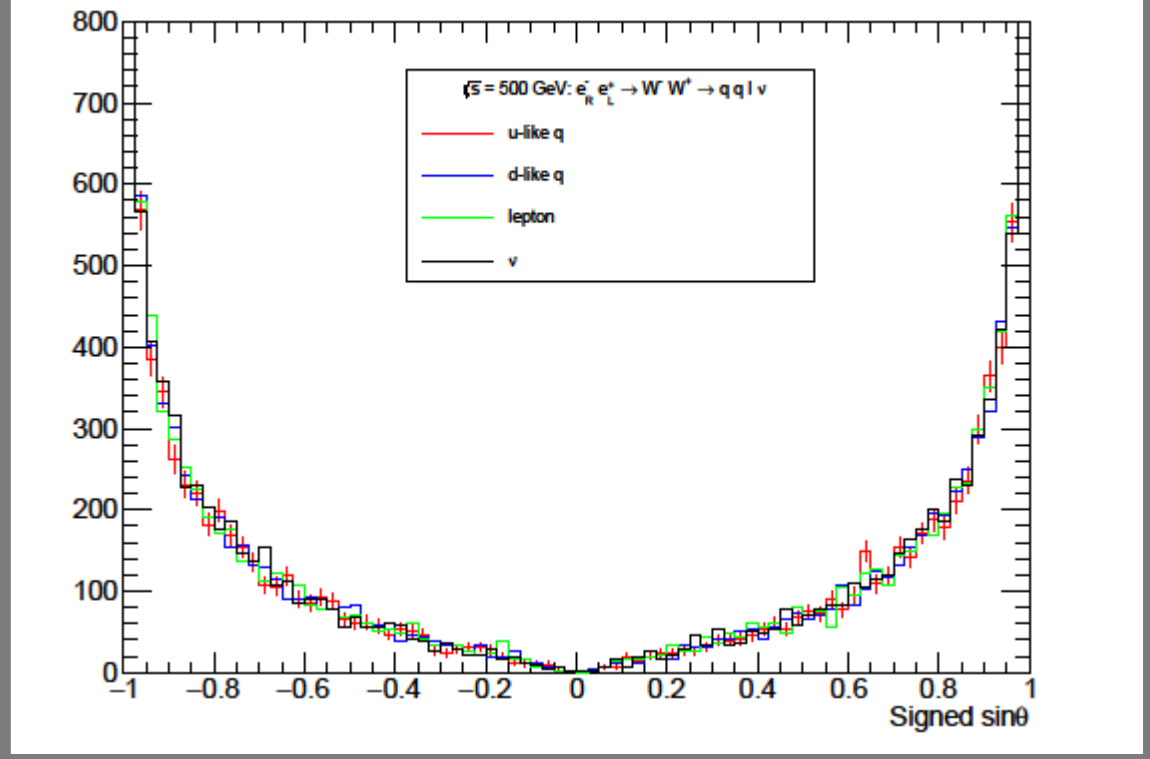
Opening angle of the lepton and the nearest quark

- Tends to have a distinct separation between the lepton and quark jets
- Similar for both polarizations

Decay Characteristics

- Sin of the polar angle of the 4 fermions
- LR the energetic fermions tend to be very forward
- RL few particles make it into the forward region



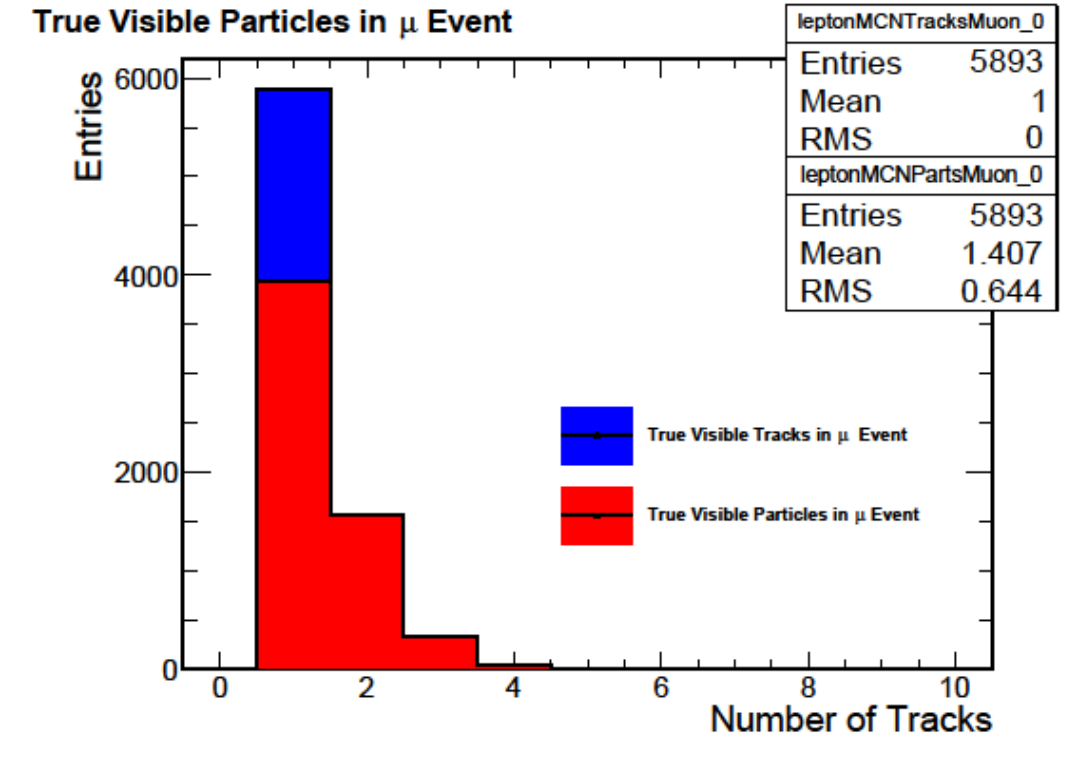


Decay Characteristics

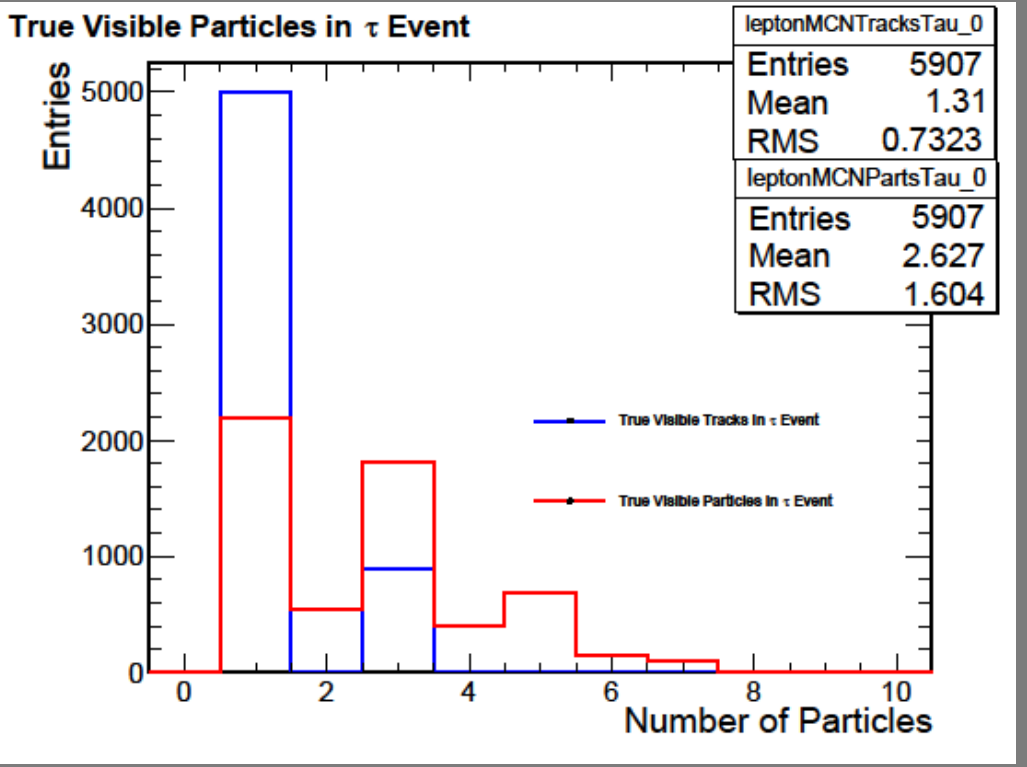
Compare multiplicities of visible neutrals/tracks for the generator lepton

- This includes FSR(s)
- Excludes showering / detector / simulation effects (like photon conversions)

μ mostly remains a single track
Sometimes a photon is radiated



τ is dominated my hadronic decays
Mostly combinations of $\pi^{\pm}, \pi^{0}$



Event Selection

Begin Reproducing known results for event selection

I. Marchesini DESY-THESIS 2011

Using 3 different background samples for now:

ee-> qq

rv02-00-01.sv02-00-01.mILD_l5_o1_v02.E500-TDR_ws.I250114.P2f_z_h.eL.pR.n001.d_dstm_10410_0.slcio

(first 3 files)

WW->qqqq

rv02-00-01.sv02-00-01.mILD_l5_o1_v02.E500-TDR_ws.I250006.P4f_ww_h.eL.pR.n001.d_dstm_10398_0.slcio

ZZ->qqll

rv02-00-01.sv02-00-01.mILD_l5_o1_v02.E500-TDR_ws.I250014.P4f_zz_sl.eL.pR.n001.d_dstm_10301_0.slcio

Event Selection

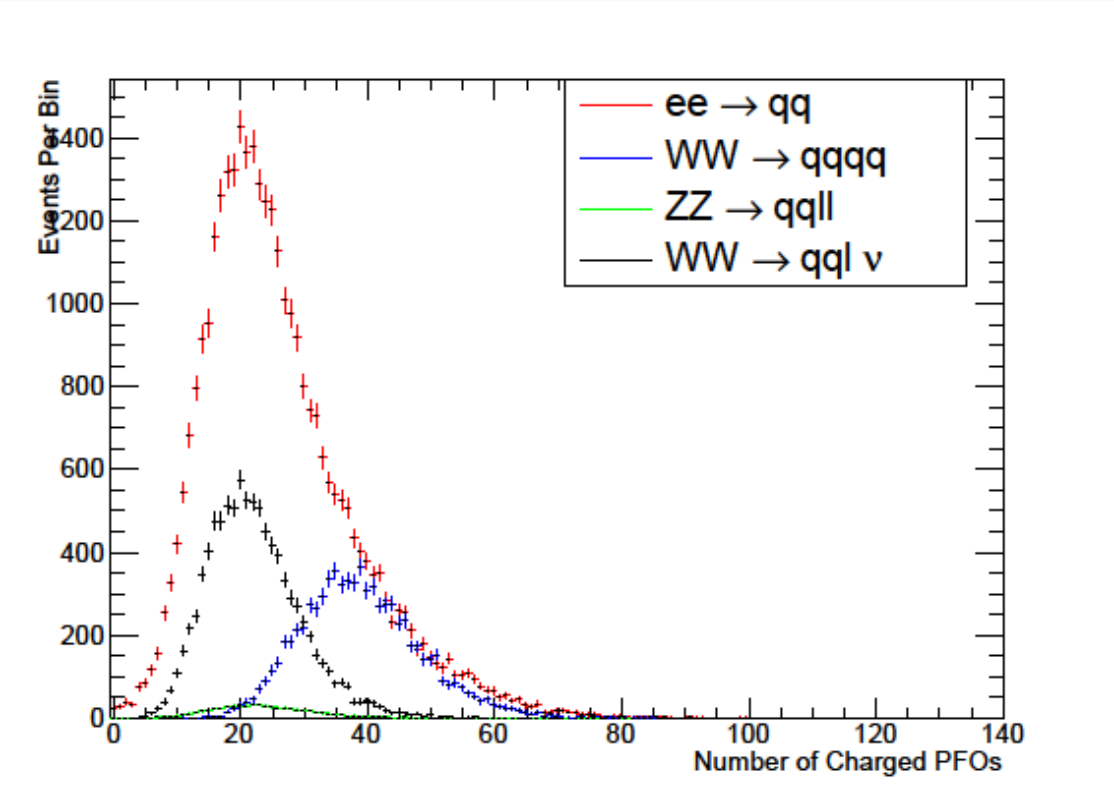
All backgrounds and signal normalized to 1 fb

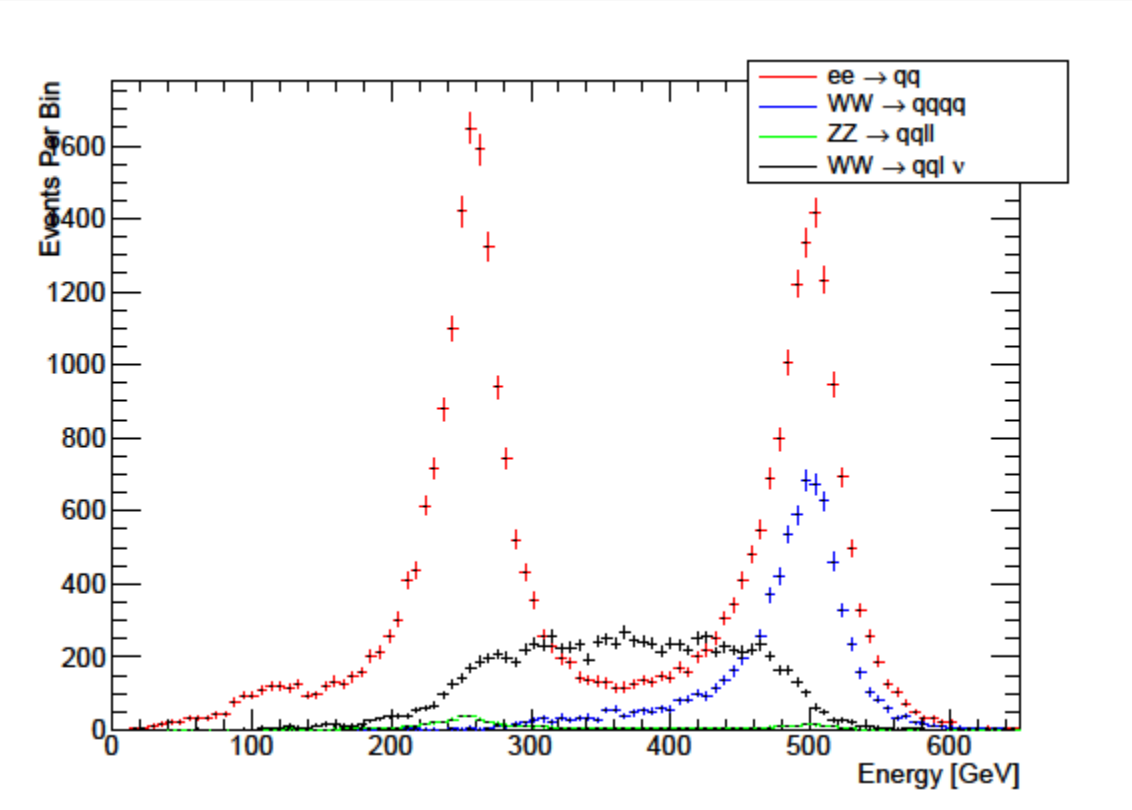
Use basic variables to proceed, with event selection-
Total number of tracks
Total Pt
Total visible E
Total Mass
Jet variables log(y-) log(y+)

Decay	σ	weight
qq	32470.5	1.061
qqqq	7680.69	1.067
qqll	608.57	0.054
qqlnu (signal)	9251.41	0.784

Event Selection

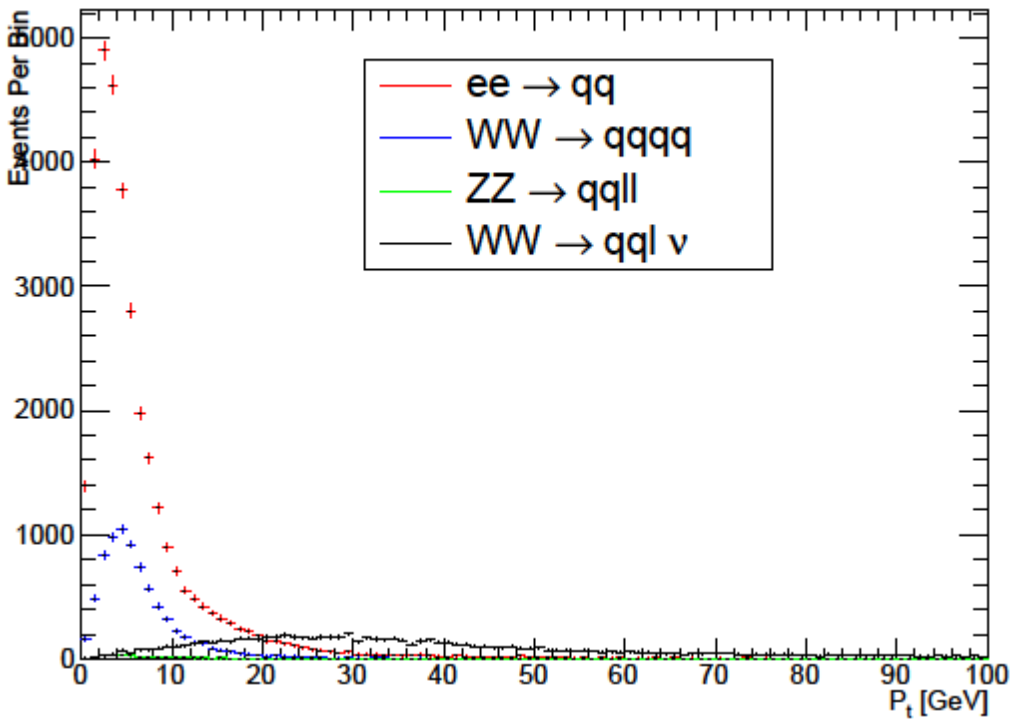
cuts: number of tracks > 10 Energy < 500 GeV

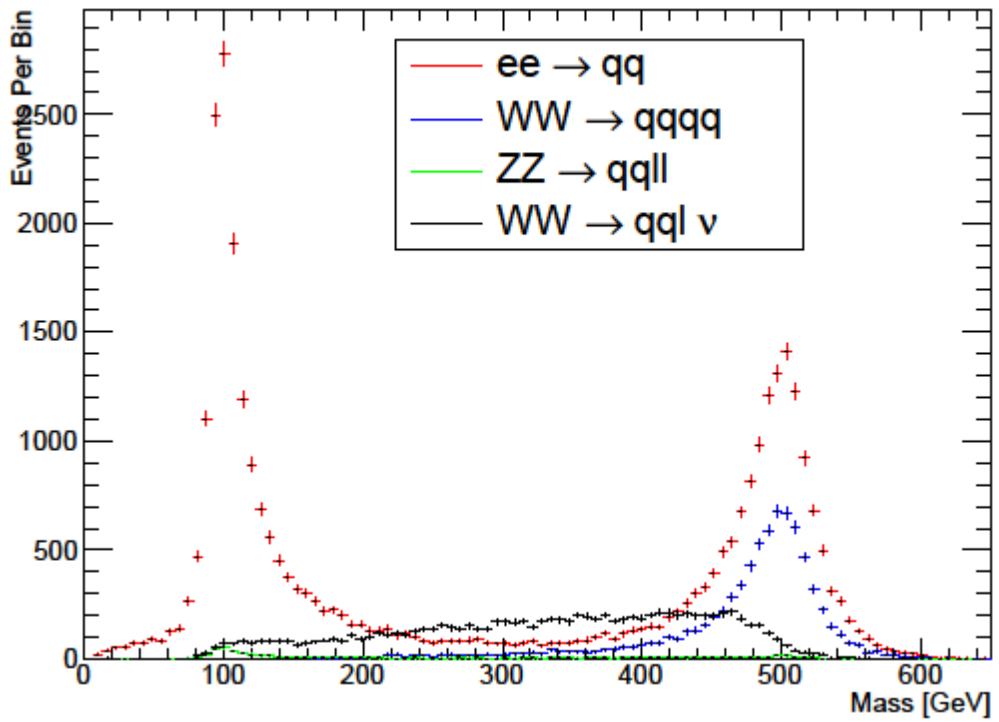




Event Selection

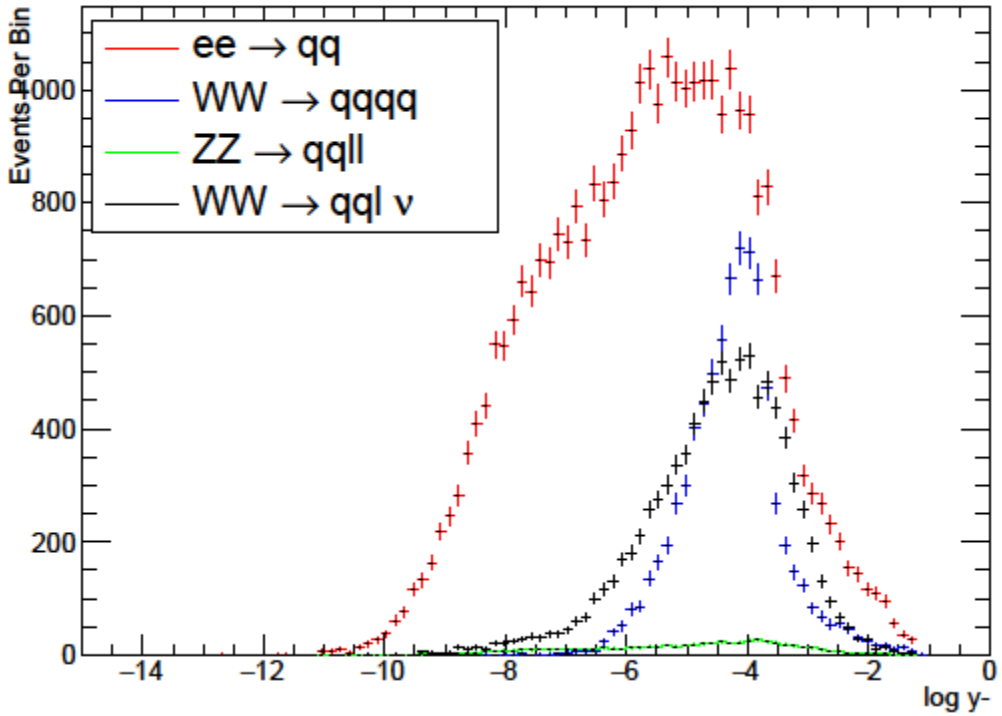
cuts: pt > 7 GeV , 80 < Mass < 500 GeV

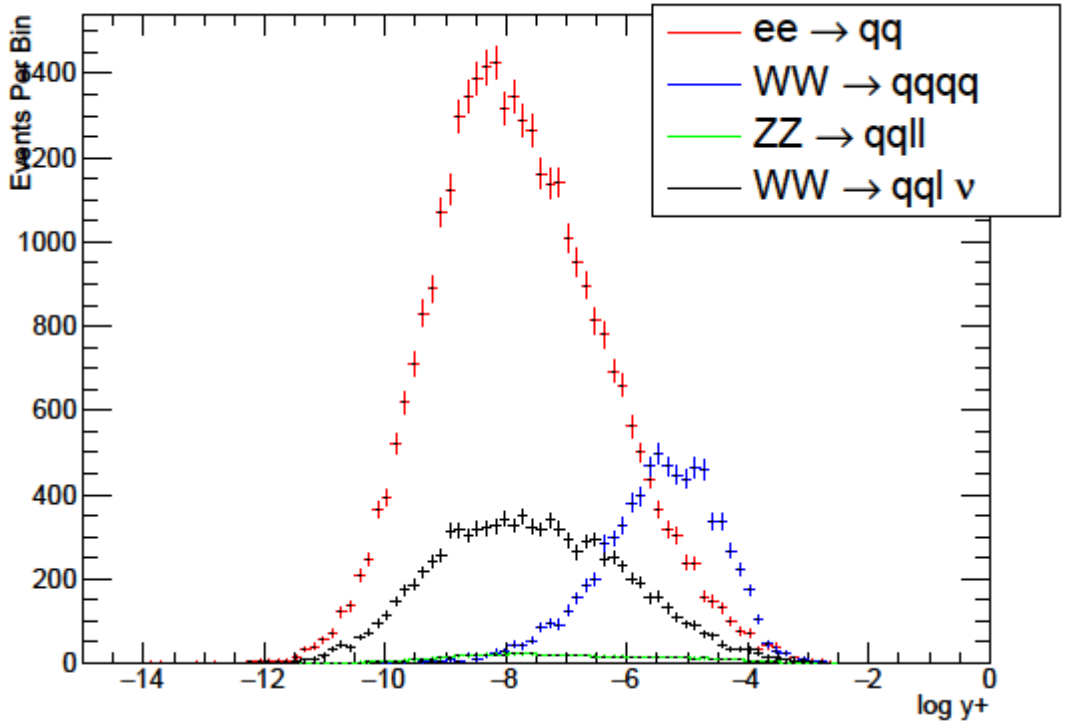




Event Selection

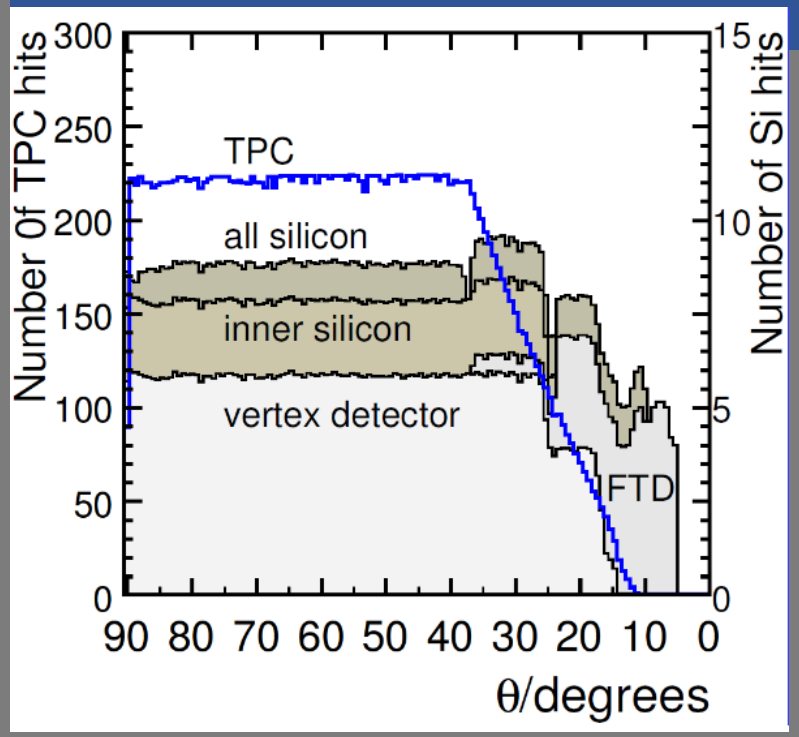
cuts: log y- > -9.5 , -12 < log y+ <-2.9





Defining Acceptance Region

- A significant portion of the events are very forward
- We define a polar angle cut to eliminating events which have no hope of reconstructing a track



Make a safe cut for now for all 3 generator particles (lqq)
Require $|\cos\theta| < 0.995$
This corresponds to the region $\theta > 5.7^{\circ}$

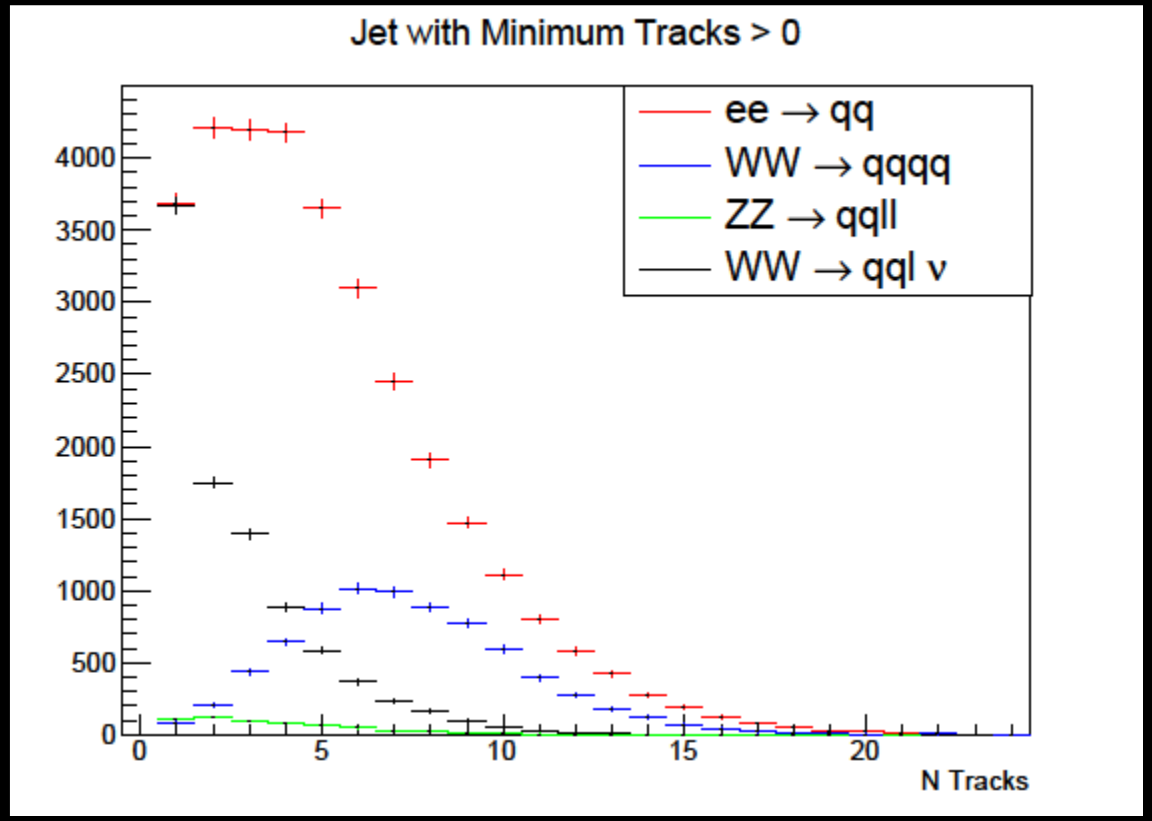
This reduces the total reconstructable events to-
$\mu : 5893 \rightarrow 5255$ and $\tau : 5907 \rightarrow 5277$
Or total signal 11800 -> 11080

Event Selection

First look at efficiency with a sequential cut flow

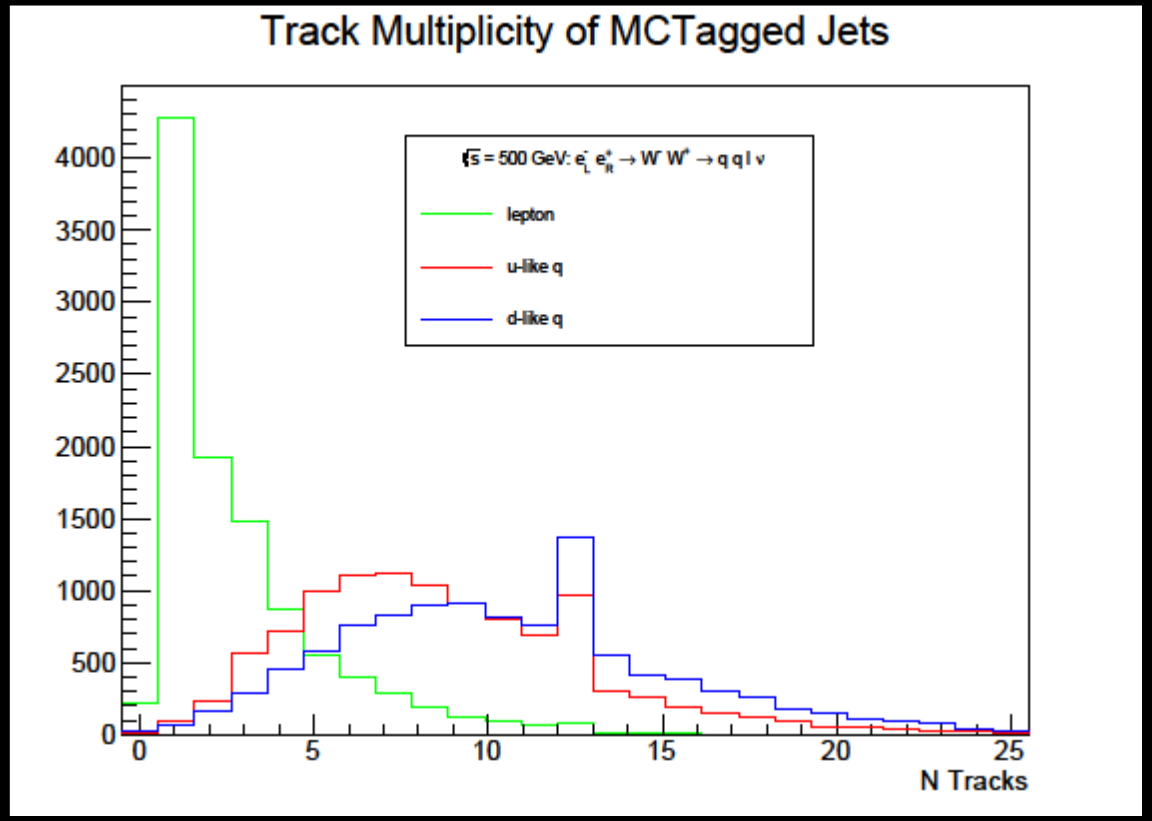
	qq	qqll	qqqq	qqlnu
Total events	30600	11200	7200	11800
|cosTheta| < 0.995	27102	10176	6398	11080
nTracks > 10	26502	9892	6398	10832
Pt > 7	8098	7672	2178	10530
E < 500	5883	7430	1246	10274
80< M < 500	5748	7262	1245	10263
Log y-	5700	7238	1245	10263
Log y+	5696	7237	1244	10262
%	**18.61**	**64.6**	**17.28**	**86.97**

Adding additional Cuts

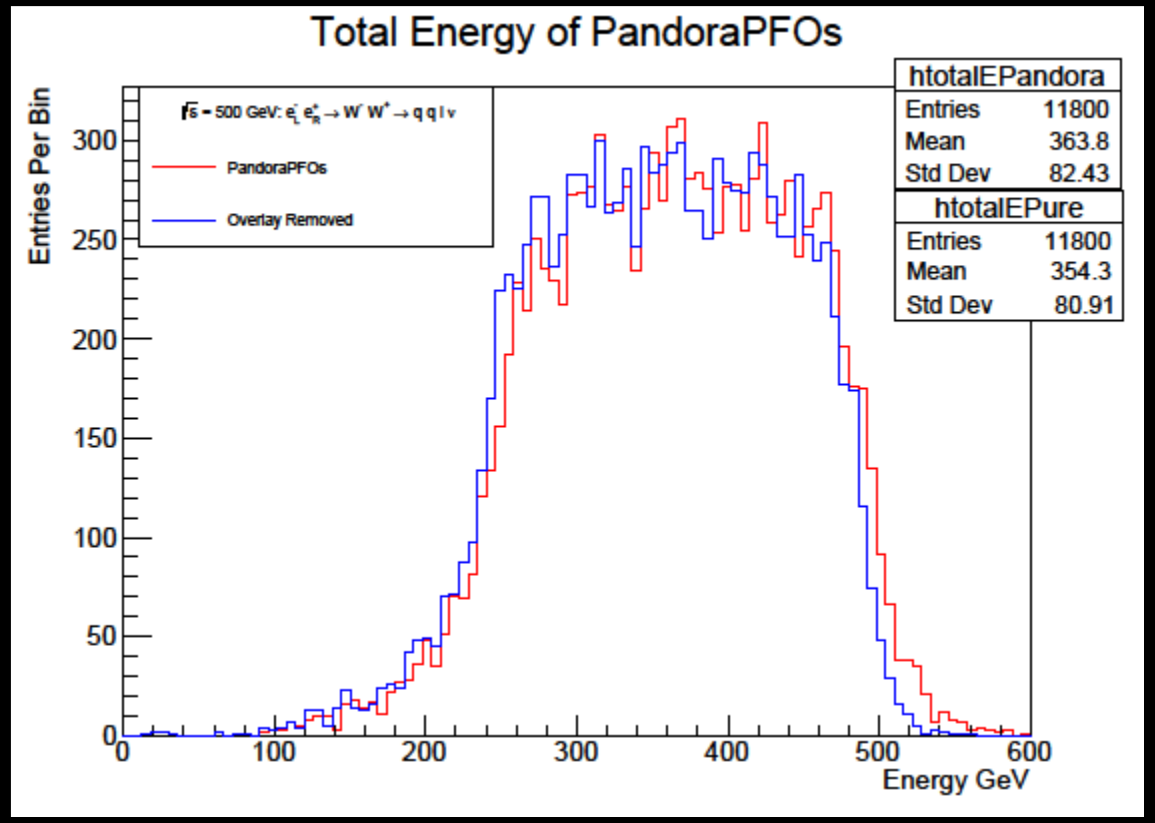


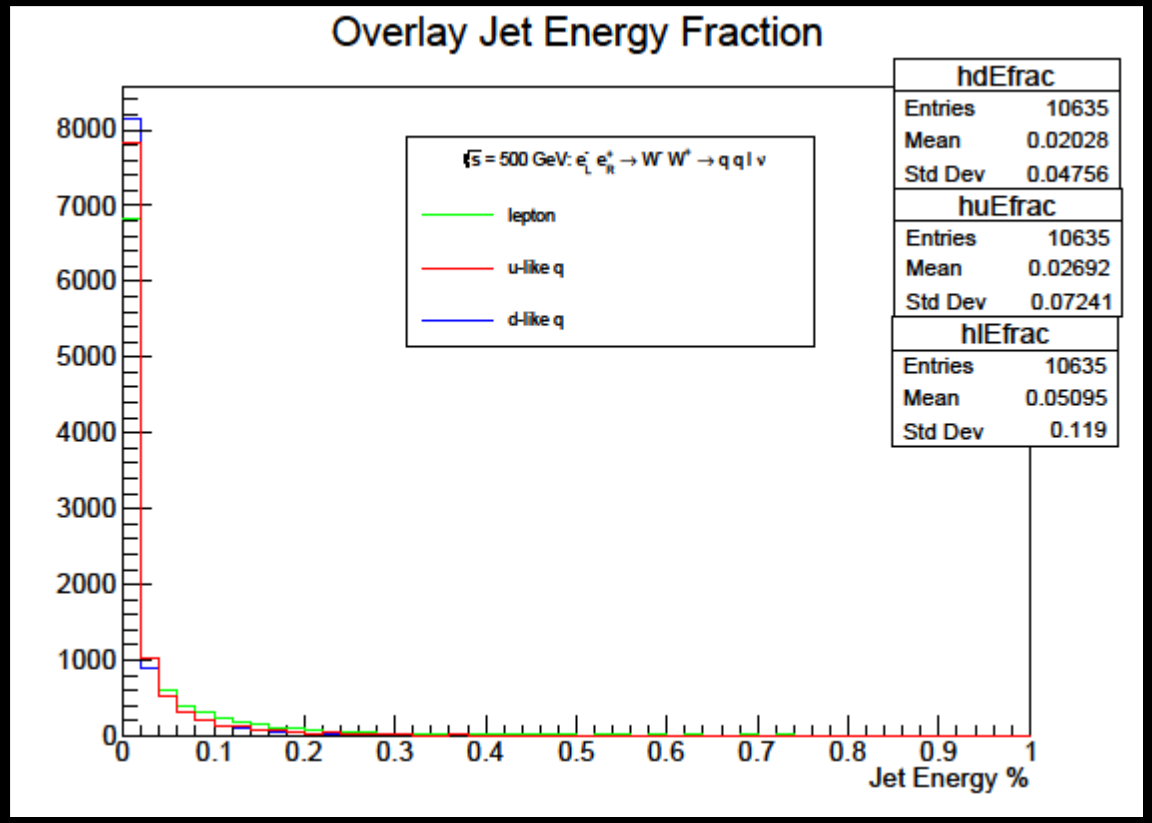
Signal track multiplicity

- MCTagging---

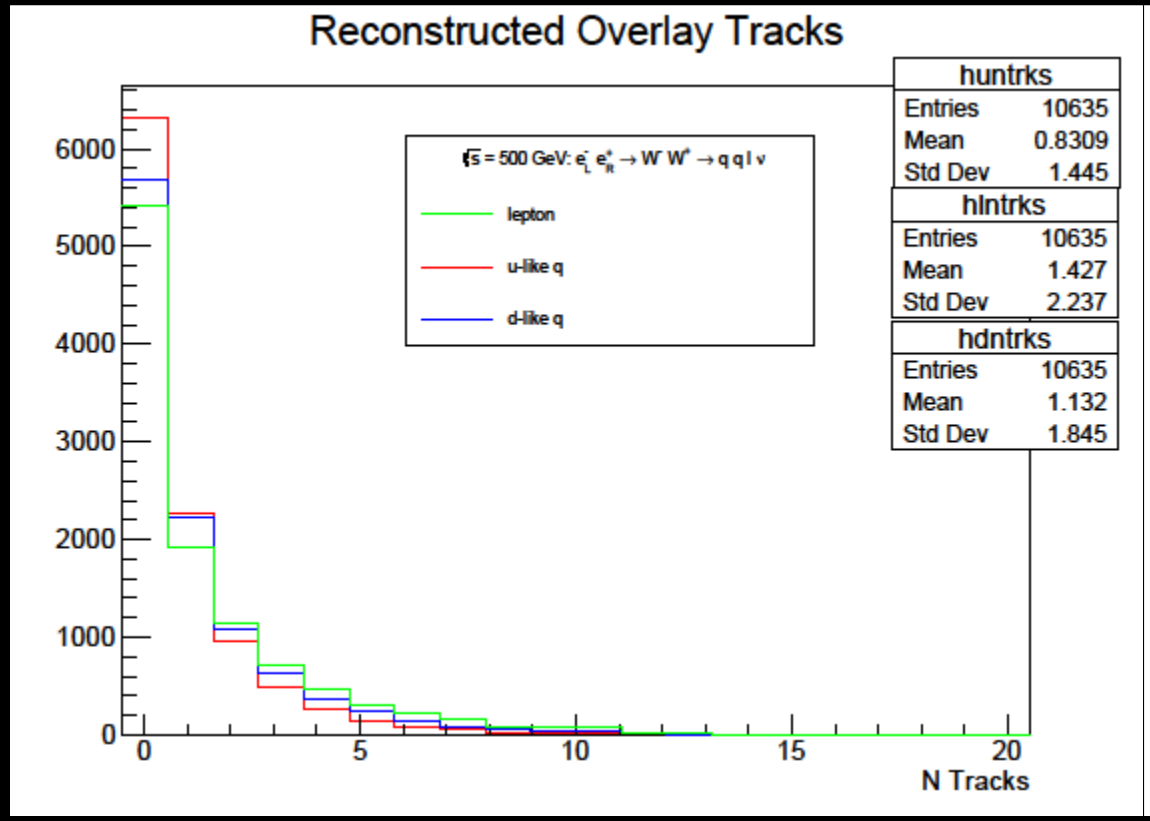


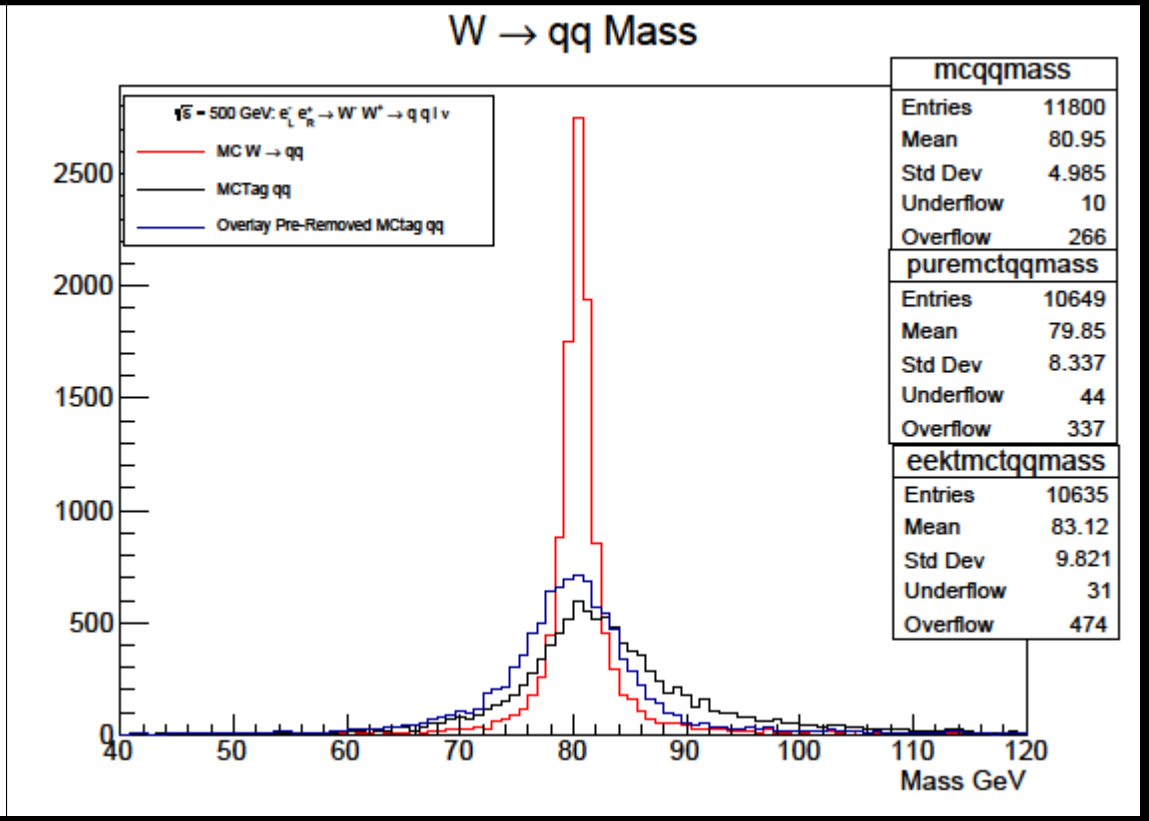
Overlay


Total Energy of PandoraPFOs
htotalEPandora
Entries 11800
Mean 363.8
Std Dev 82.43
htotalEPure
Entries 11800
Mean 354.3
Std Dev 80.91
PandoraPFOs
Overlay Removed
Entries Per Bin
Energy GeV


Overlay Jet Energy Fraction
hdEfrac
Entries 10635
Mean 0.02028
Std Dev 0.04756
huEfrac
Entries 10635
Mean 0.02692
Std Dev 0.07241
hlEfrac
Entries 10635
Mean 0.05095
Std Dev 0.119
lepton
u-like q
d-like q
Jet Energy %

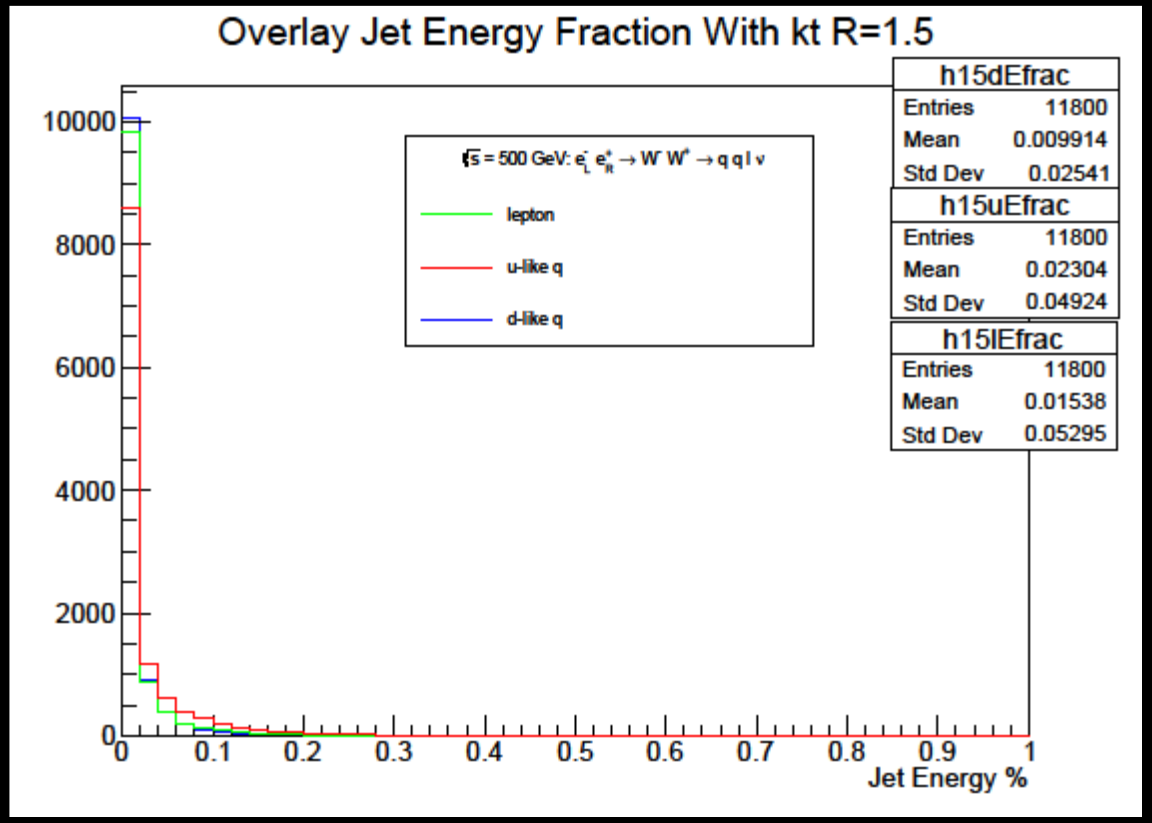
Overlay

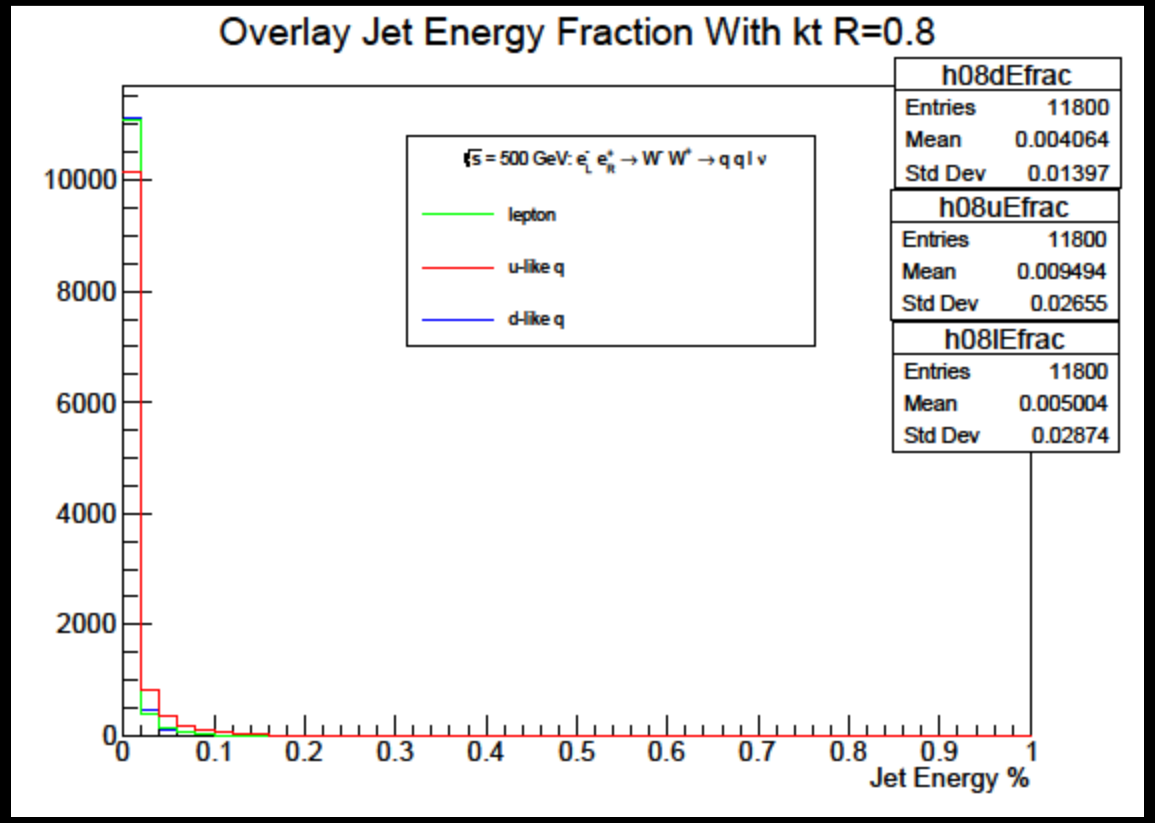

Reconstructed Overlay Tracks
huntrks
Entries 10635
Mean 0.8309
Std Dev 1.445
hlntrks
Entries 10635
Mean 1.427
Std Dev 2.237
hdntrks
Entries 10635
Mean 1.132
Std Dev 1.845
lepton
u-like q
d-like q
N Tracks


W → qq Mass
mcqqmass
Entries 11800
Mean 80.95
Std Dev 4.985
Underflow 10
Overflow 266
puremctqqmass
Entries 10649
Mean 79.85
Std Dev 8.337
Underflow 44
Overflow 337
eektmctqqmass
Entries 10635
Mean 83.12
Std Dev 9.821
Underflow 31
Overflow 474
MC W → qq
MCTag qq
Overlay Pre-Removed MCtag qq
Mass GeV

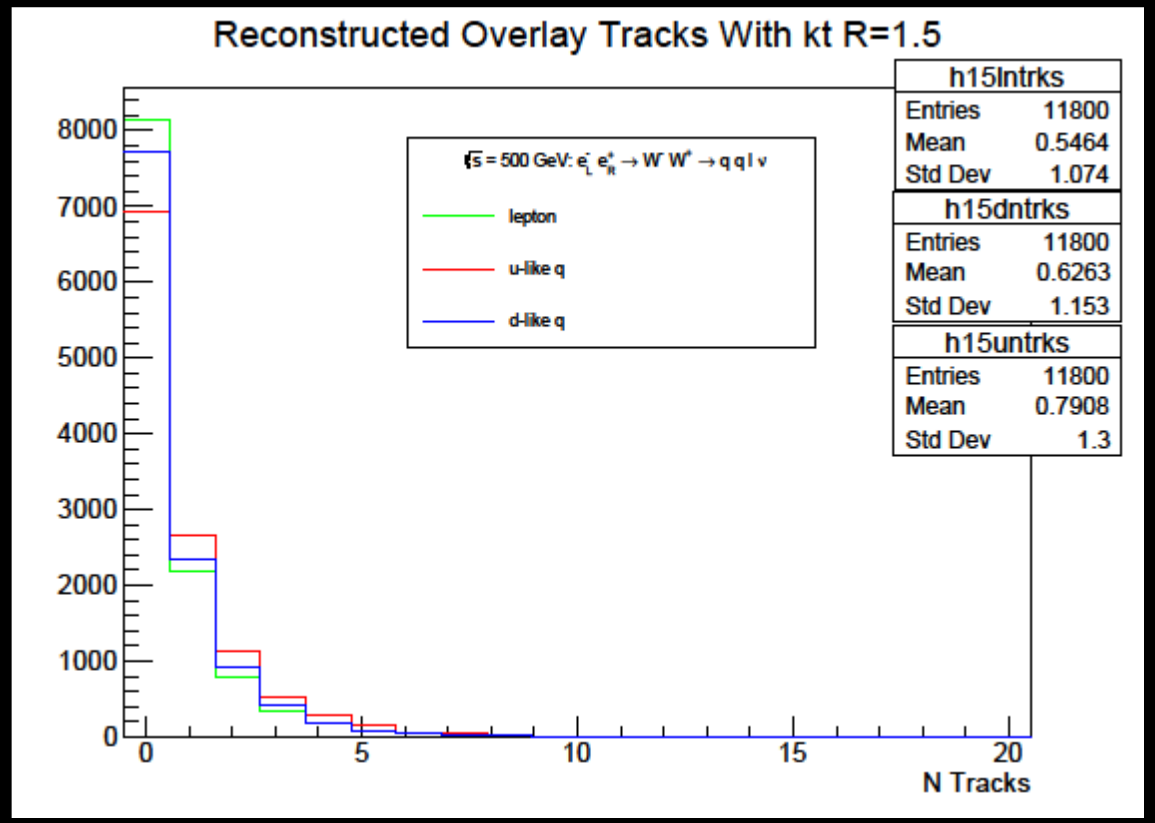
Removal techniques

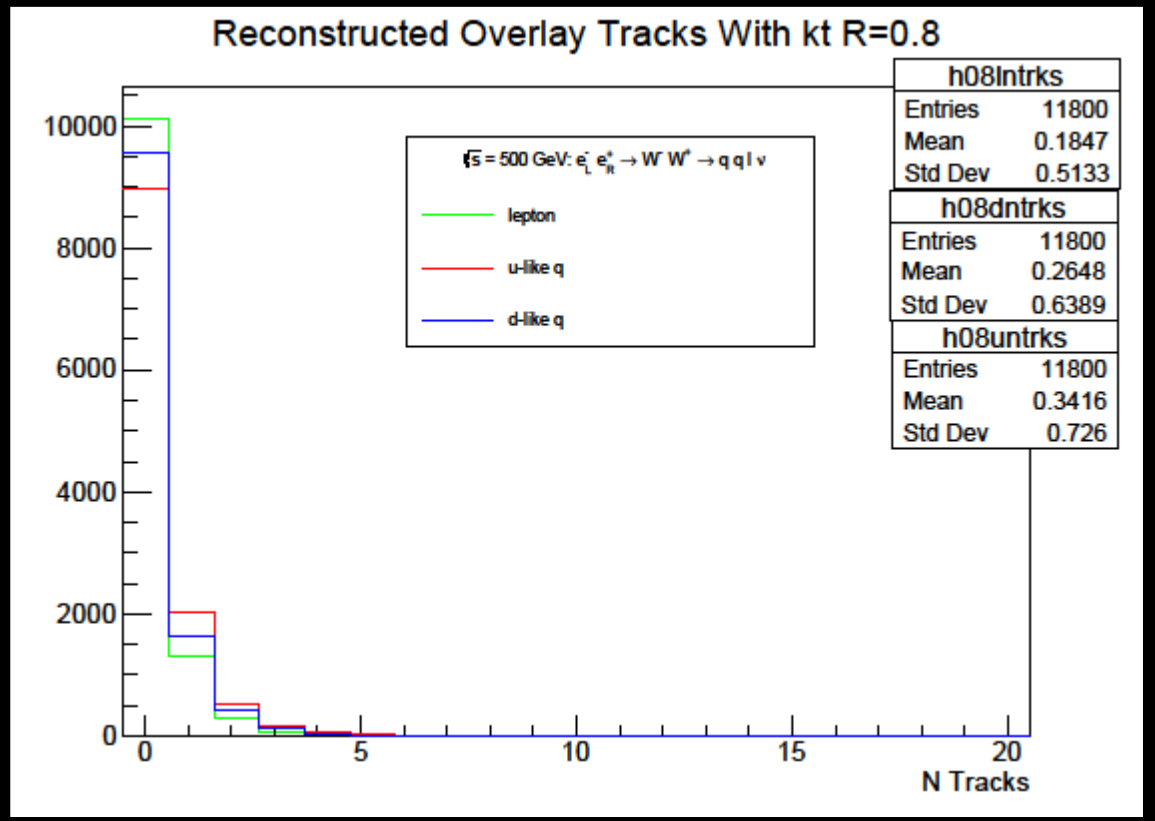
- Preprocessor
- Kt R=1.5, R=0.8 -> eekt N=3jets



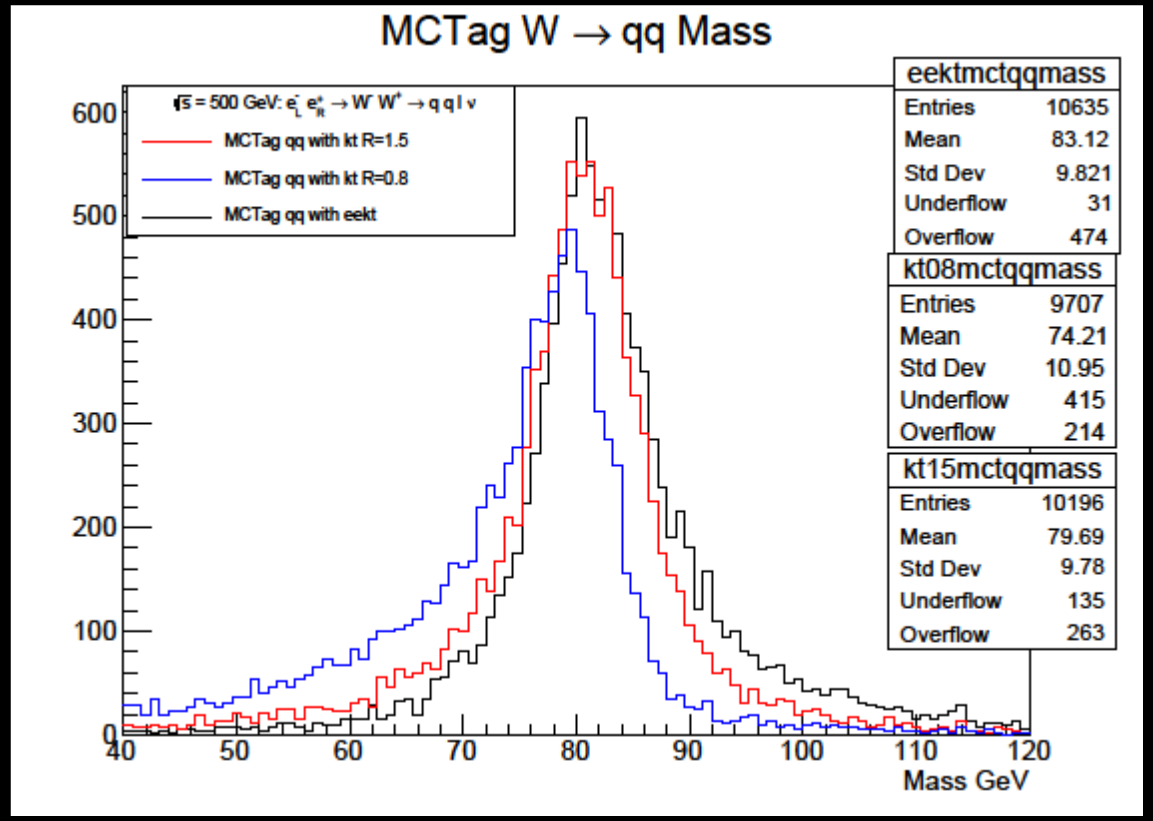


Removal techniques





Overlay removal hadronic mass



- TODO: Plot primary physics observables with cuts+no overlay+mctagging
- Also calculate performance metrics