MID-RAPIDITY W EVENT SELECTION

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LIST OF CUTS

vertex
par_minPileupVert=3; // to reject events w/o TPC, lower it for MC
par_vertexZ=100; // (cm)

towers
par_kSigPed=3; // rawADC-ped cut off
par_AdcThres=8; // ADC threshold to avoid correlated noise
par_maxADC=200.; // (adc chan) on the highest tower in events

track
par_nFitPts=15; // hits on the track
par_nHitFrac=0.51;
par_trackRin=90; par_trackRout=160; // cm
par_trackPt=10.;//GeV
par_highET=25.; // (GeV), cut-off for final Barrel W-cluster
par_QET2PTlow = 0.4; // low cut on |Q*ET/PT|
par_QET2PThigh = 1.8; // high cut on |Q*ET/PT|

//... search for W's
par_nearDeltaR=0.7; //(~rad) near-cone size
par_awayDeltaPhi=0.7; // (rad) away-'cone' size

setEtowScale(1.0);
setBtowScale(1.0);

Barrel Algo
par_clustET=14.; // (GeV/c) 2x2 cluster ET
par_clustFrac24=0.95; // ET ratio 2x2/4x4 cluster
par_nearTotEtFrac=0.88; // ratio 2x2/near Tot ET
par_delR3D=7.; // cm, dist between projected track and center of cluster
par_leptonEtaLow=-1.5; // bracket acceptance
par_leptonEtaHigh=1.5; // bracket acceptance
par_ptBalance=14.; // (GeV), ele cluster vector + jet sum vector

TRIGGER

L2BW

- L2BW Trigger used to select W candidate events online from the decay electrons in the barrel EMC.

- L2BW trigger involved a 2-stage energy requirement in the BEMC towers

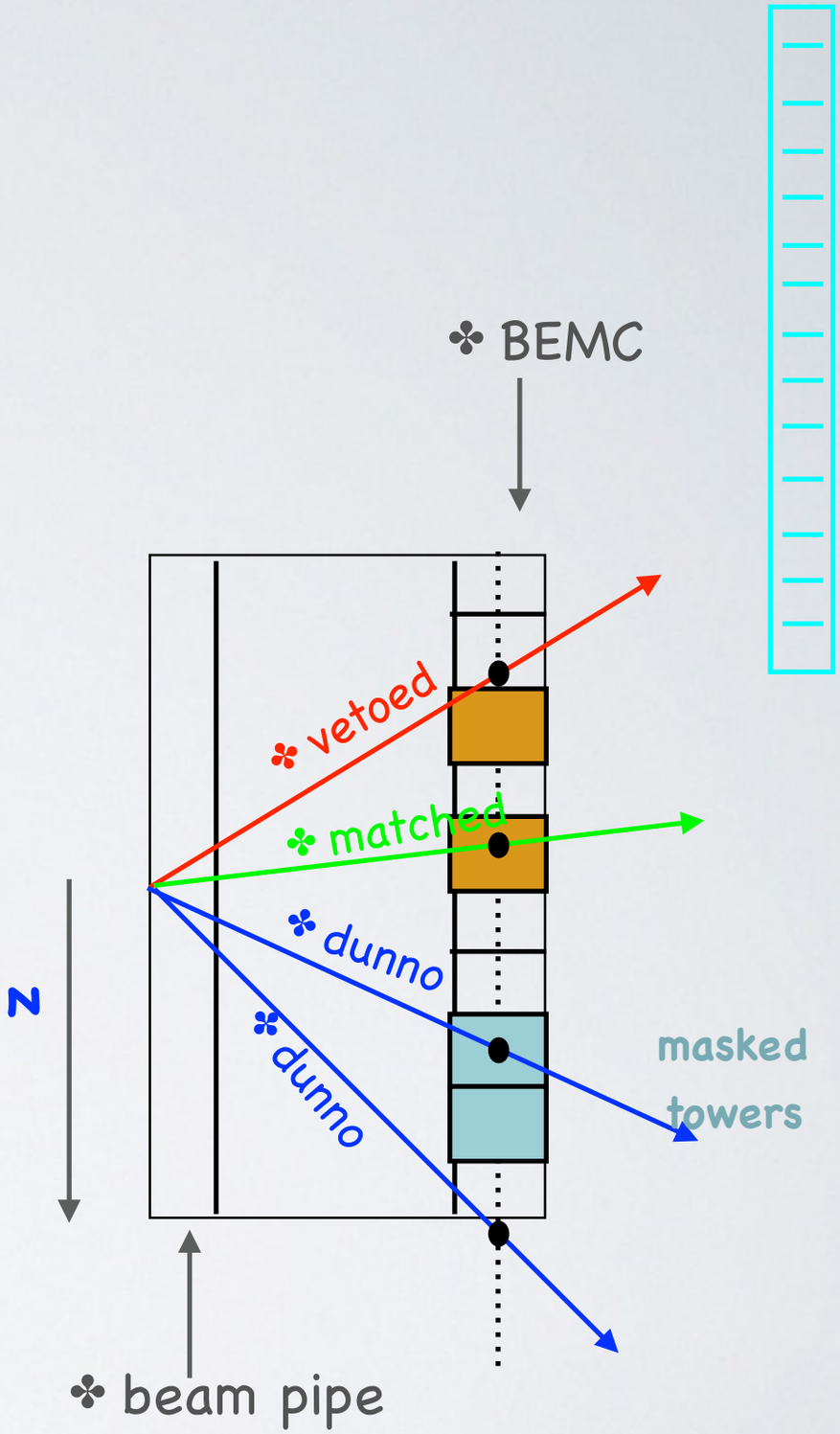
- At level 0 (hardware level) : a single BEMC tower contain a deposited energy above a threshold of E_T = 7.3 GeV => BHT3 , E_T > 7.3 GeV

- At level 2 (software algo. level) : a seed tower with deposited energy E_T > 5 GeV and maximum 2x2 tower cluster include the seed tower have an E_T sum > 12 GeV

PRIMARY VERTEX SELECTION

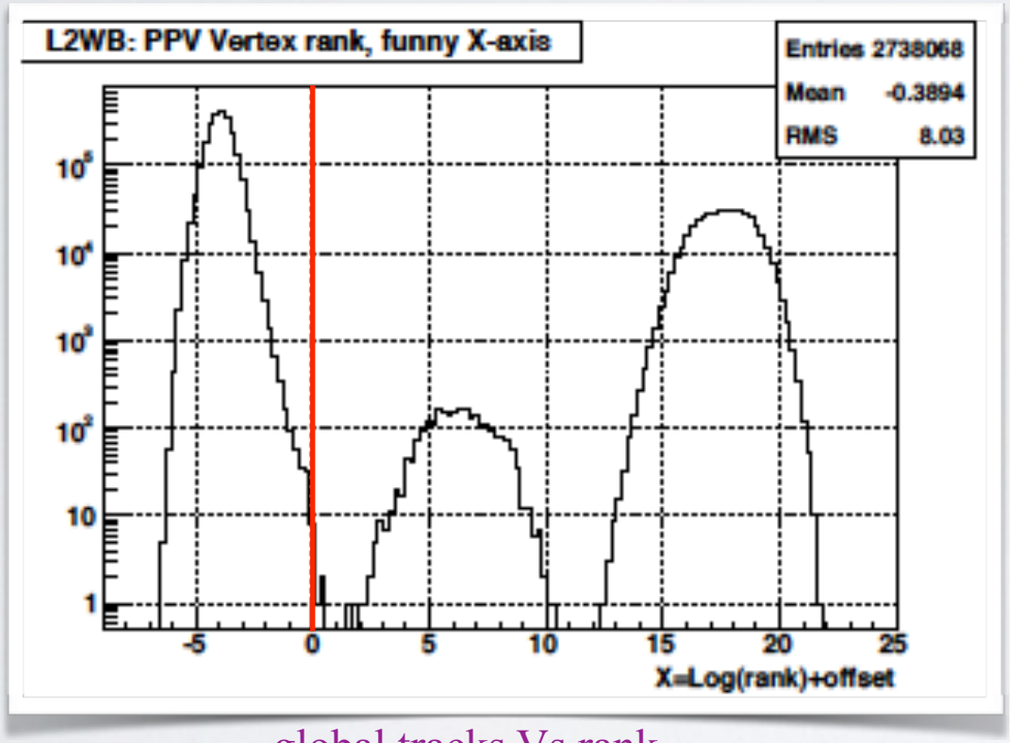
PPV (Pile-up Proof Vertex Finder)

- PPV use to determine the vertex location along the z axis for low multiplicity events embedded in 2 orders of magnitude larger pileup
  - PPV first select good global tracks : P_T > 2 GeV, nHits / nPoss > 0.51, DCA_{xy} < 2 cm
- Then weight global tracks based on the matching conditions to fast detectors BEMC, EEMC, BTOF
  - Extrapolated global tracks fired BTOW, ETOW or
  - Use TPC hits from either side of the TPC central membrane
- Use cumulative likelihood function to find vertex Z as the weighted mean of all global tracks approaching the beam line within 2 cm distance.

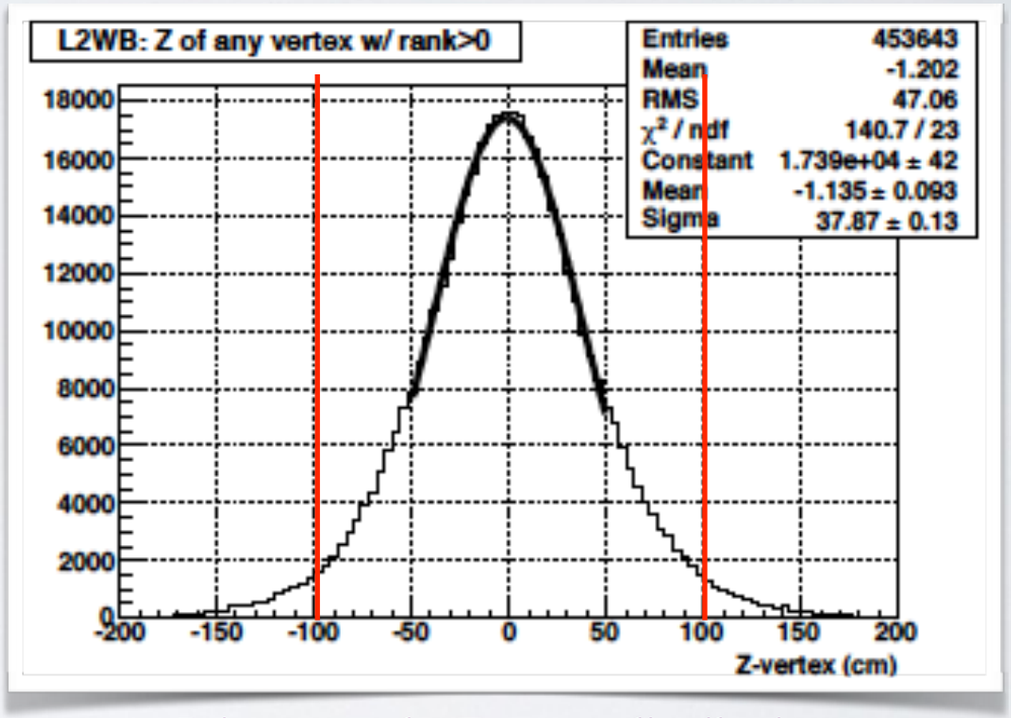


PPV (Pile-up Proof Vertex Finder)

- For a valid primary vertex,
  - requires at least 2 high quality matched tracks or
  - single primary track with PT >10 GeV /c matched to the fired tower



global tracks Vs rank



Primary tracks Z-vertex distribution

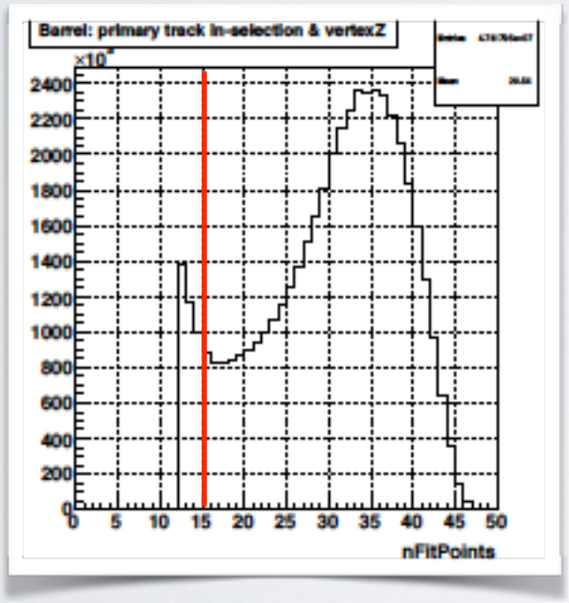
w algo requirement :

- all vertices with |Vz| < 100 cm and rank > 0

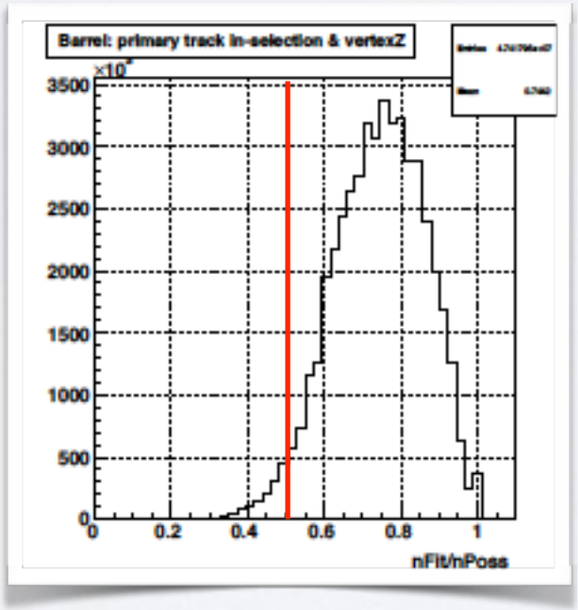
BARREL ISOLATED $e^{\pm}$ SELECTION

1) Finding Quality (primary) Tracks

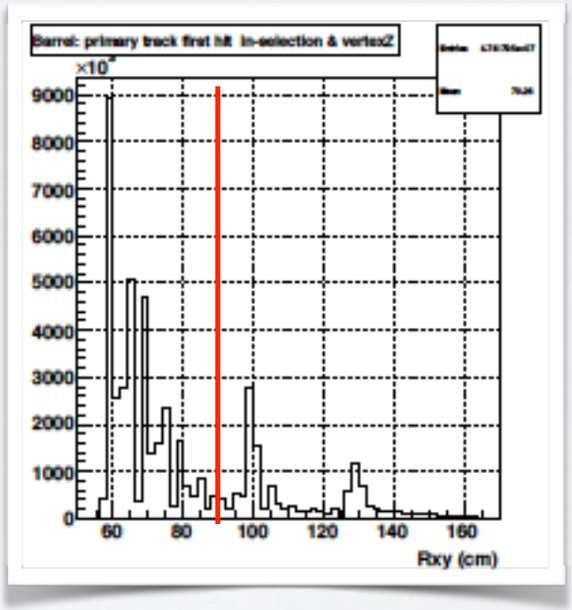
- primary track "flag" = 301
- primary track nFitPoints > 15
- Fraction of track hits used in the reconstruction out of possible track hits > 0.51
- radius of the track hit nearest to the beam line < 90 cm
- radius of the track hit farthest from the beam line > 160 cm
- primary tracks have P_T > 10 GeV



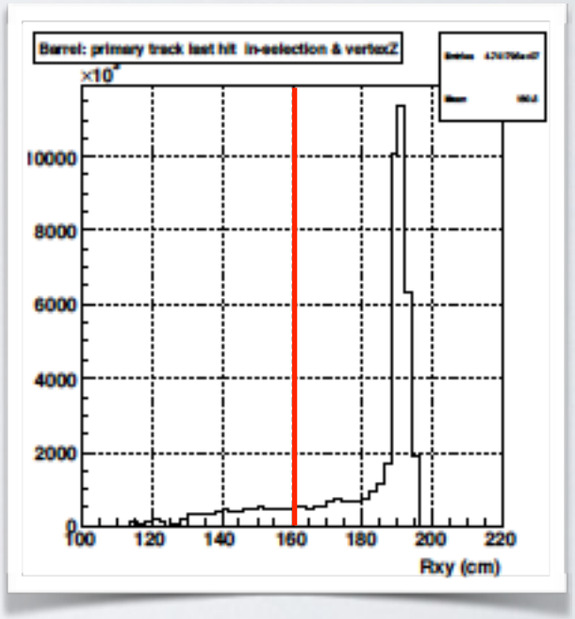
primary tracks nFitPoints



primary tracks nFitPoints / nPossible



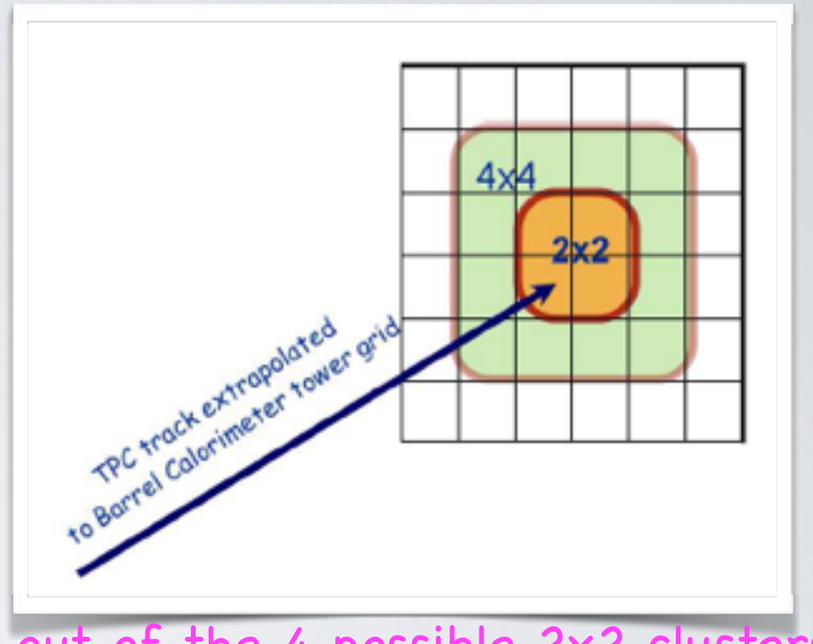
primary tracks first hit from the beam line



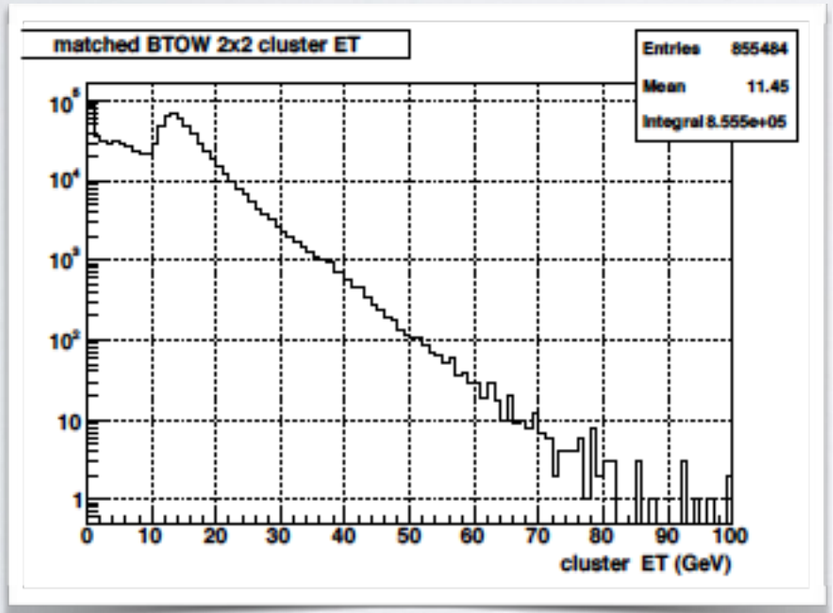
primary tracks last hit from the beam line

2) Track and Cluster Matching

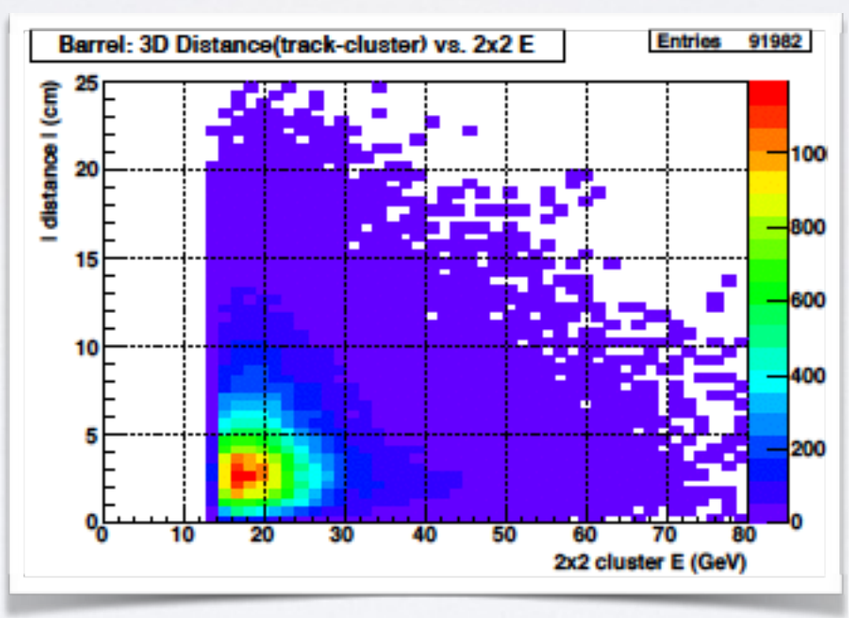
- 2x2 cluster E^e_T > 14 GeV
- magnitude of the 2D distance between energy log-weighted centroid of the tower and the extrapolated track < 7 cm



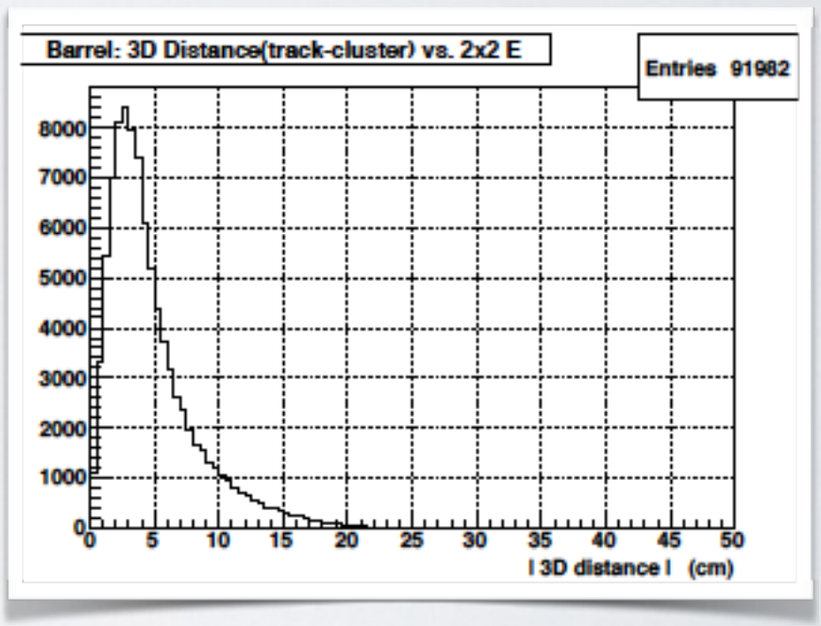
E^e_T = highest E_T sum associate with the 2x2 BTOW tower cluster out of the 4 possible 2x2 clusters containing the pointed TPC $e^{\pm}$ candidate track



BTOW 2x2 cluster ET



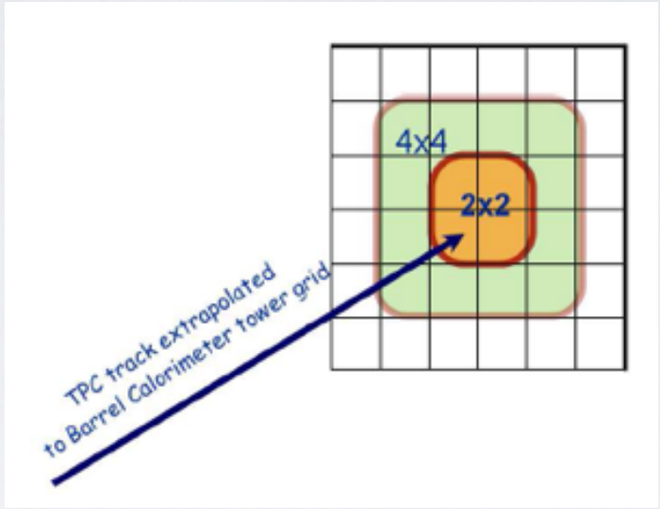
3D distance difference
(track-BTOW 2x2 cluster ET center) Vs ET

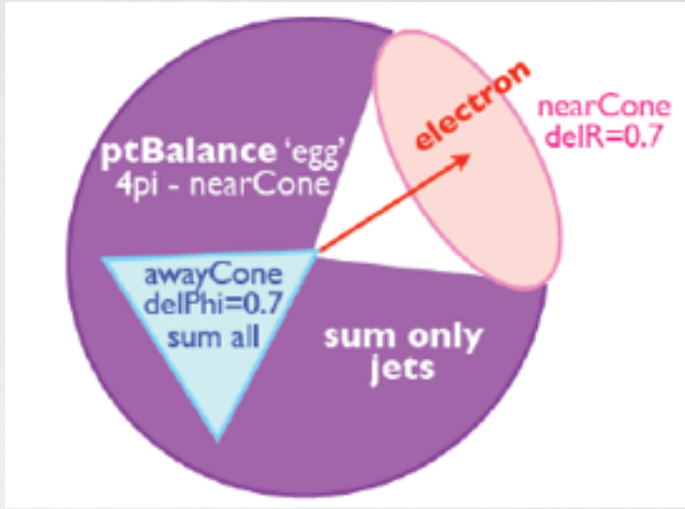


3D distance difference
(track-BTOW 2x2 cluster ET center)

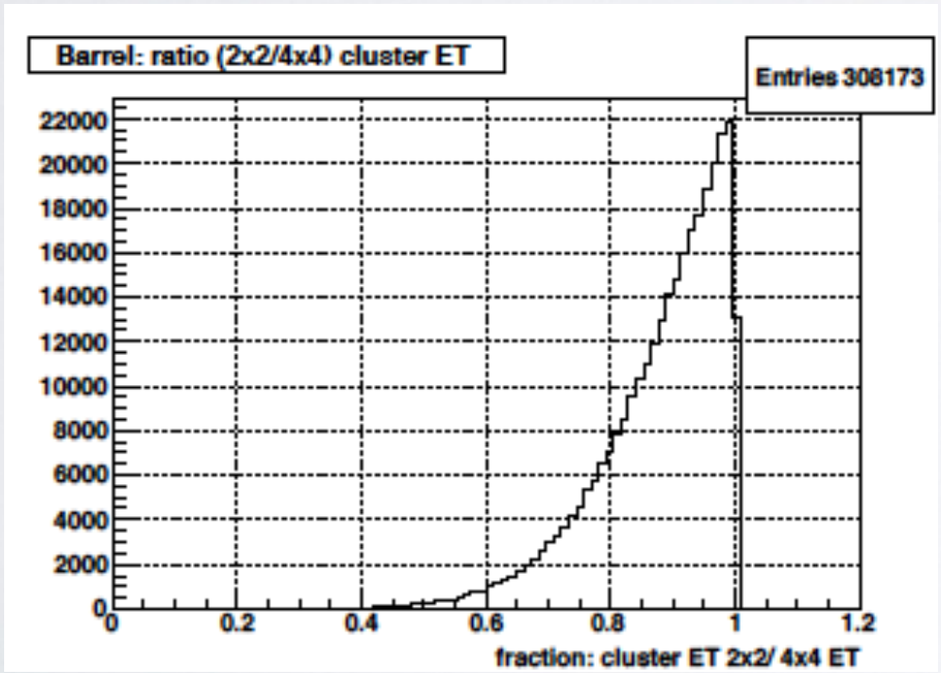
3) Isolating candidate leptons in the cluster

- E^{e}_{T} / E^{4x4}_{T} > 0.95
- E^{e}_{T} / $E^{\Delta R<0.7}_{T}$ > 0.88

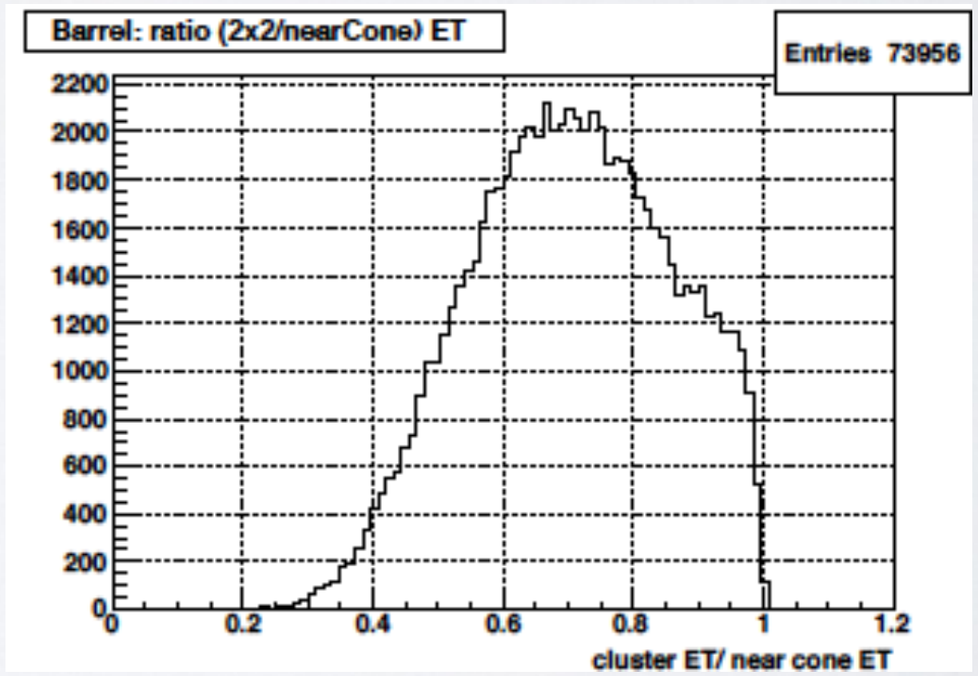




$E^{\Delta R<0.7}_{T}$ = Tower E^{T}_{BTOW} + Tower E^{T}_{ETOW} + TPC track P_T in a cone radius $\Delta R < 0.7$ around the candidate



BTOW 2x2 / 4x4 cluster ET

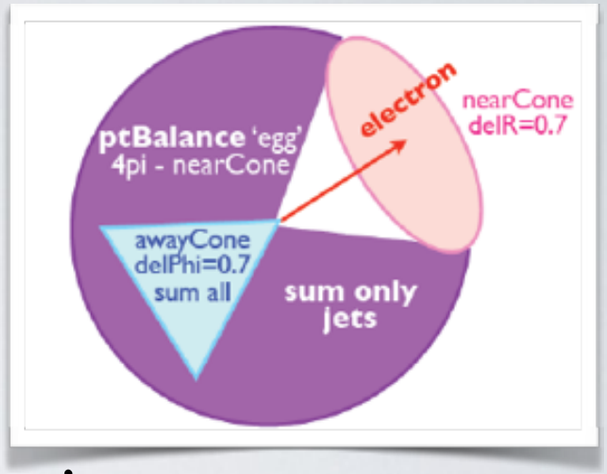


BTOW 2x2 / near cone cluster ET

W CANDIDATE EVENT SELECTION

1) Sign PT-Balance requirement

this is the implementation of large missing transverse energy opposite in ϕ of the $e^{\pm}$ candidate W event due to undetected neutrino in W-boson production



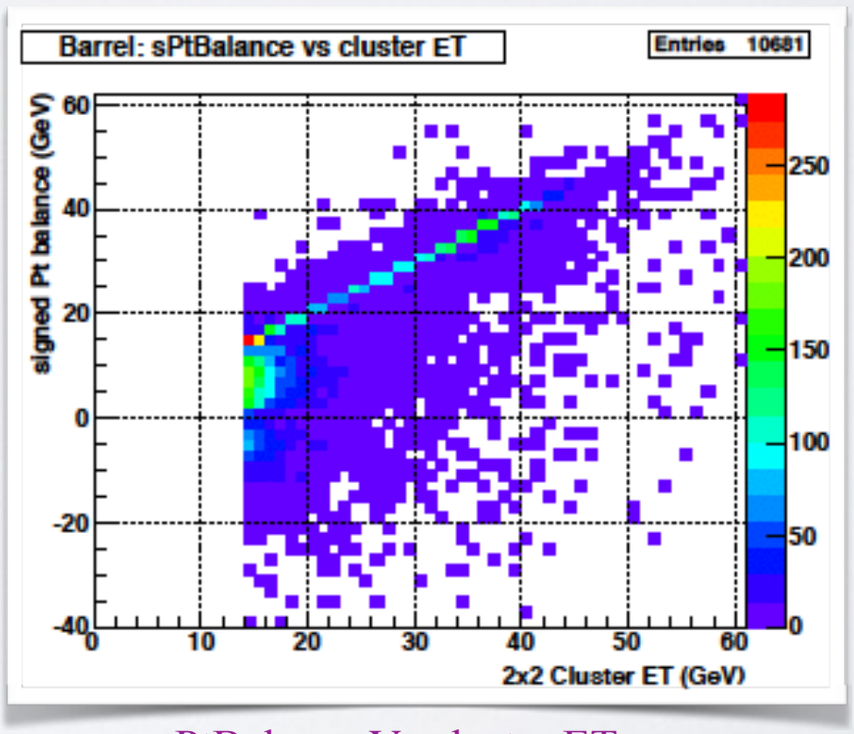
$$\vec{p_T}^{\,bal} = \vec{p_T}^{\,e} + \sum_{\Delta R>0.7} \vec{p_T}^{\,jets}$$

$$P_T\text{-balance}\cos(\phi) = \frac{\vec{p}_T^{\,e} \cdot \vec{p}_T^{\,bal}}{|\vec{p}_T^{\,e}|}$$

→ very small for a QCD jet event

→ ~ P^e_T for a W event

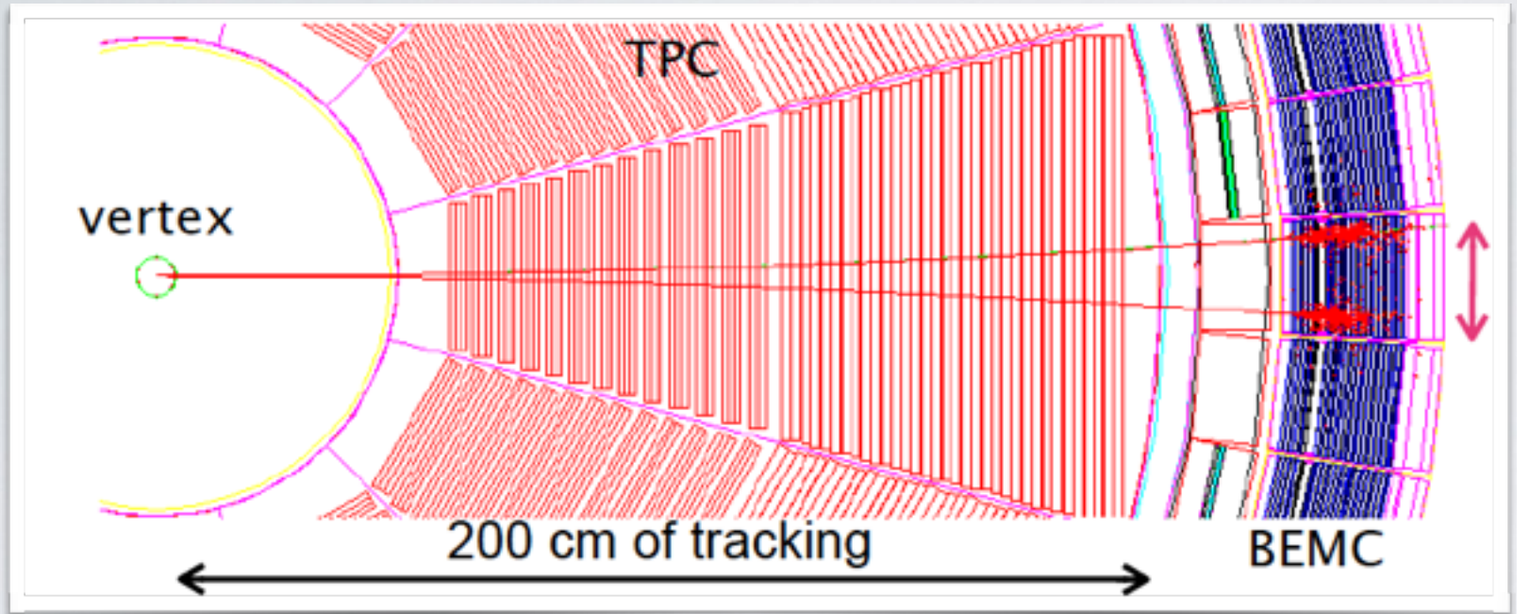
- Signed PT-balance > 14 GeV/c



sPtBalance Vs cluster ET

jets are reconstructed using standard anti-kT algorithm: Selection cuts => slide 13

1) Charge sign Reconstruction



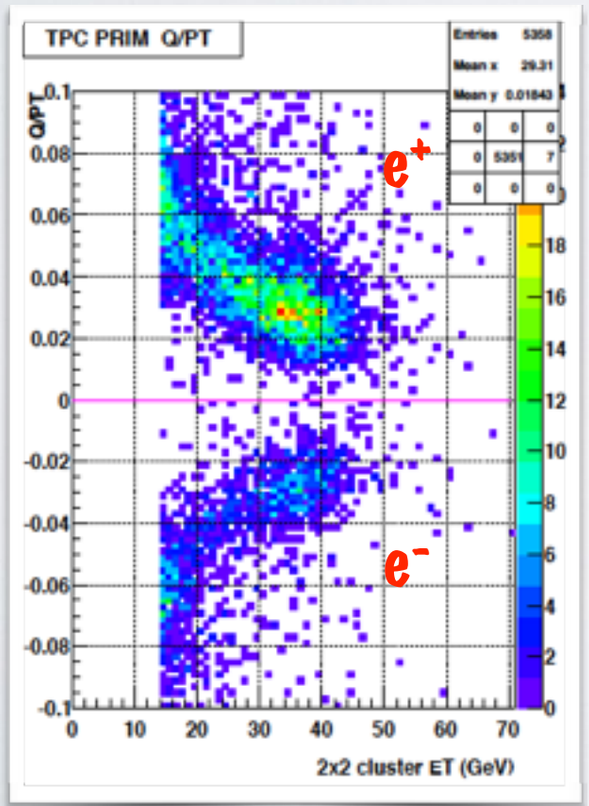
e^+ , P_T = 5 GeV

e^- , P_T = 5 GeV

+/- distance D: ~ $1/P_T$

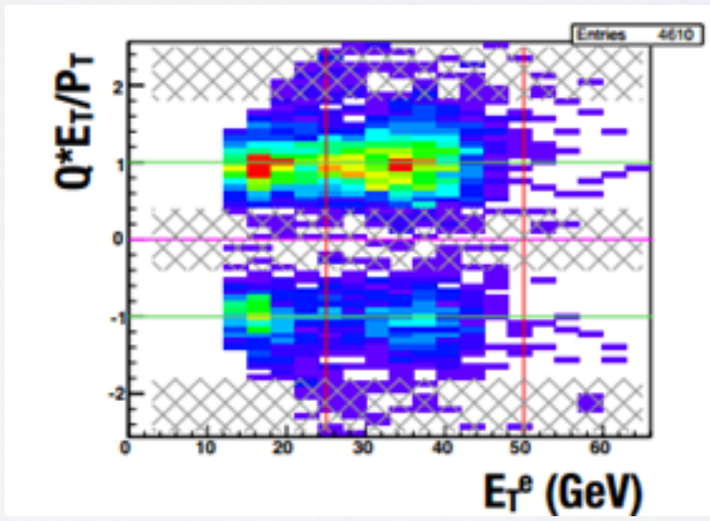
P_T = 5 GeV : D~ 15cm

P_T = 40 GeV : D~ 2cm

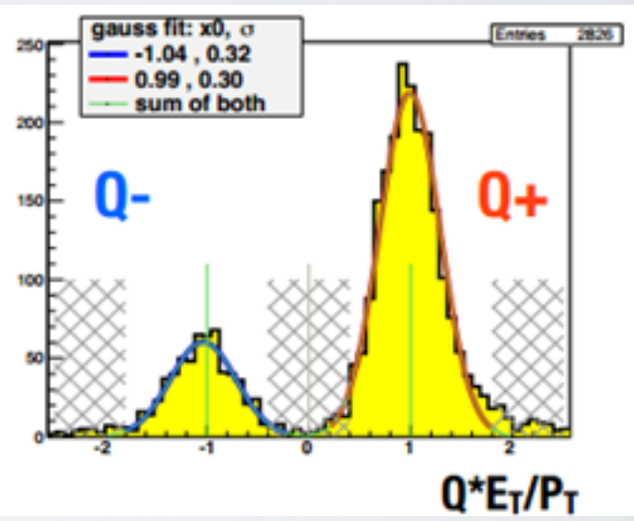


- Q/P_T = > 0 e^+
- Q/P_T = <0 e^-

Q/P_T vs E_T



$Q*E_T/P_T$ vs E_T



$Q*E_T/P_T$ for 25 < E_T < 50 GeV

|Q*ET/PT| > 0.4

|Q*ET/PT| < 1.8

BACKGROUND EVENT SELECTION

W $\longrightarrow \tau + \nu$ MC sample

- use all the events selection cuts explained before except W event selection requirement (sign PT balance, charge sign)
- $|\eta_e| < 1$

Z $\longrightarrow$ **e** + **e** MC sample

JET FINDING PARAMETERS

```
// Set analysis cuts for 12-point branch
StAnaPars* anapars12 = new StAnaPars;
anapars12->useTpc = true;
anapars12->useBemc = true;
anapars12->useEemc = true;
anapars12->setTowerEnergyCorrection(new\
StjTowerEnergyCorrectionForTracksFraction(1.00));
```

```
// TPC cuts
anapars12->addTpcCut(new StjTrackCutFlag(0));
anapars12->addTpcCut(new StjTrackCutNHits(12));
anapars12->addTpcCut(new StjTrackCutPossibleHitRatio(0.51));
anapars12->addTpcCut(new StjTrackCutDca(3));
anapars12->addTpcCut(new StjTrackCutTdcaPtDependent);
anapars12->addTpcCut(new StjTrackCutPt(0.2,200));
anapars12->addTpcCut(new StjTrackCutEta(-2.5,2.5));
anapars12->addTpcCut(new StjTrackCutLastPoint(125));
```

```
// BEMC cuts
anapars12->addBemcCut(new StjTowerEnergyCutBemcStatus(1));
anapars12->addBemcCut(new StjTowerEnergyCutAdc(4,3));
anapars12->addBemcCut(new StjTowerEnergyCutEt(0.2));
```

```
// EEMC cuts
anapars12->addEemcCut(new StjTowerEnergyCutBemcStatus(1));
anapars12->addEemcCut(new StjTowerEnergyCutAdc(4,3));
anapars12->addEemcCut(new StjTowerEnergyCutEt(0.2));
```

```
// Jet cuts
anapars12->addJetCut(new StProtoJetCutPt(3.5,200));
anapars12->addJetCut(new StProtoJetCutEta(-100,100));
```

```
// Set anti-kt R=0.6 parameters
StFastJetPars* AntiKtR060Pars = new StFastJetPars;
AntiKtR060Pars->setRparam(0.6);
AntiKtR060Pars->setRecombinationScheme(StFastJetPars::E_scheme);
AntiKtR060Pars->setStrategy(StFastJetPars::Best);
AntiKtR060Pars->setPtMin(3.5);

jetmaker->addBranch("AntiKtR060NHits12",anapars12,AntiKtR060Pars);
```

ENDCAP CUTS

```
//... Endcap Algo
  parE_trackEtaMin=0.7; // avoid bad extrapolation to ESMD
  parE_clustET=14.; // (GeV/c) 2x2 cluster ET
  parE_clustFrac24=0.90; // ET ratio 2x2/4x4 cluster
  parE_nearTotEtFrac=0.85;  // ratio 2x2/near Tot ET
  parE_delR3D=10.; // cm, dist between projected track and center of cluster
  parE_leptonEtaLow=0.7; // bracket acceptance
  parE_leptonEtaHigh=2.5; // bracket acceptance
  parE_ptBalance=14.; // (GeV), ele cluster vector + jet sum vector
  //... track
  parE_nFitPts=5; // hits on the track
  parE_nHitFrac=0.51;
  parE_trackRin=120;  parE_trackRout=70; // cm
  parE_trackPt=7.;//GeV
  parE_nSmdStrip=20;
  parE_esmdGL=3; // 2N+1=7 size of the integration gate len
  parE_esmdWL=7; // 2N+1=15 size of the allowed window len

  parE_smdRatio=0.6;
  parE_highET=25.; // (GeV), cut-off for final Endcap W-cluster
  parE_QET2PTlow = 0.4;  // low cut on |Q*ET/PT|
  parE_QET2PThigh = 1.8; // high cut on |W*ET/PT|

  assert(2*parE_nSmdStrip+1==41);// as hardcoded in Wtree for esmdShower[mxEsmdPlane][], it should be solved by using
<vector> or TArray - left for next year to be fixed
  assert(parE_esmdGL<=parE_esmdWL); // if equal then peak adjusting is disabled
  assert(parE_esmdWL<parE_nSmdStrip);
```

// irrelevant for W analysis

```
par_DsmThres=31; // only for monitoring
parE_DsmThres=31; // only for monitoring
par_maxDisplEve=1; // # of displayed selected events
```

MC trigger simulator

```
par_l0emulAdcThresh=30;
par_l2emulSeedThresh=5.0;
par_l2emulClusterThresh=12.0;
```