

Top Mass Measurements with the P_T balance method

Top Mass Meeting

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Introduction

- ▶ Preliminary studies of the “ P_T balance method” as an alternative method to reconstruct and measure the top mass, are here presented
- ▶ This work is still ongoing/”work in progress” (with Sven Menke).
- ▶ For the analysis Cone 4 jets and k_T 4 jets with Local Hadron Calibration (LC) and with the H1 calibration (H1) have been considered
- ▶ The “ P_T balance method” has been already used to measure the W mass for the T2 CSC note with the ATLAS release 12.0.6



DPDs with $t\bar{t} \rightarrow WWb\bar{b} \rightarrow (l\nu)(jj)b\bar{b}$ events

- ▶ The data analyzed here are $t\bar{t} \rightarrow WWb\bar{b} \rightarrow (l\nu)(jj)b\bar{b}$
- ▶ DPDs, about 162200 events have been produced with release 14.2.21,
- ▶ Data sample used: 105200 Task ID=26357 with the HEC C Quadrant 8 missing
- ▶ These DPDs contain the following extra jet containers “with B-tag information”:
 - ▷ k_T 4LCTopoJets: k_T 4 topo-jets with LC
 - ▷ k_T 6LCTopoJets: k_T 6 topo-jets with LC
 - ▷ Cone4LCTopoJets: Cone4 topo-jets with LC
- ▶ Results with the default Cone4 jets are also presented:
 - ▷ Cone4H1TowerJets: tower-jets with H1
- ▶ The default jets Cone4H1TopoJets could not be used in the analysis because they don't have B-tag information. I could not rebuild the H1 jets from the AODs



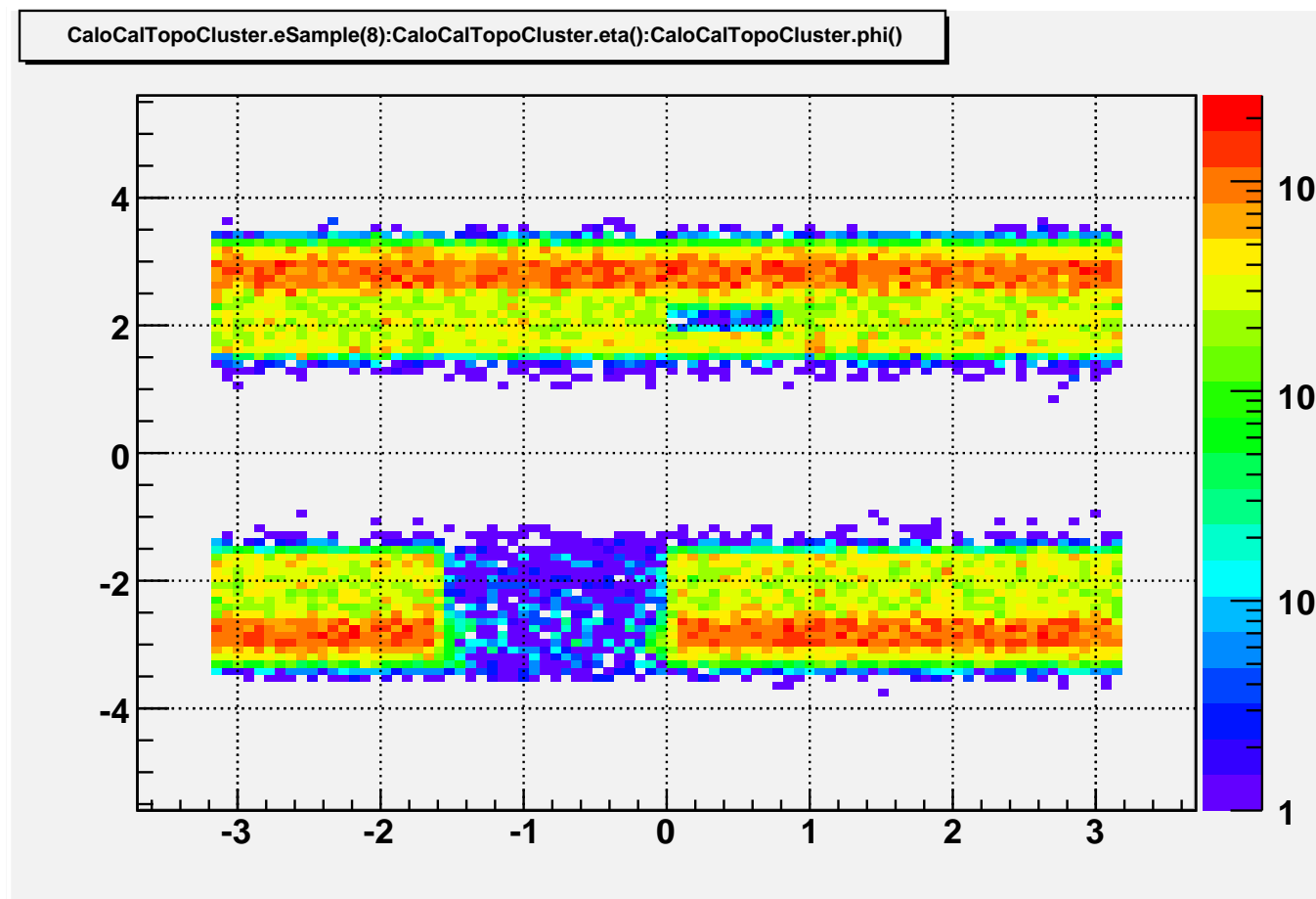
Event Selection P_T balance method

- ▶ Jets selection:
 - ▷ 3 jets with $p_{\perp} > 40$ GeV
 - ▷ 1 jet with $p_{\perp} > 20$ GeV
 - ▷ $|\eta| < 2.5$
 - ▷ B-tag used on two jets
- ▶ Exclude events with the HEC C Quadrant 8 missing
- ▶ Exactly one isolated electron or muon with:
 - ▷ $p_{\perp} > 20$ GeV, $|\eta| < 2.5$
 - ▷ Muons reconstructed with STACO; electrons with eGamma and $isEM = 0$
- ▶ $MET > 20$ GeV (used MET_RefFinal)
- ▶ Used the P_T balance method to combine the 4 good selected jets (2 B-jets and 2 light-jets) into top and W
 - ▷ Used B-tag and the 3 jets with $p_{\perp} > 40$ GeV to decrease the combinatorial background



Dataset 105200 with HEC C Quad. 8 missing

- Plot shows the cluster energy reconstructed in the front part of HEC1 wheel (HEC sampling 1) for HEC A and HEC C

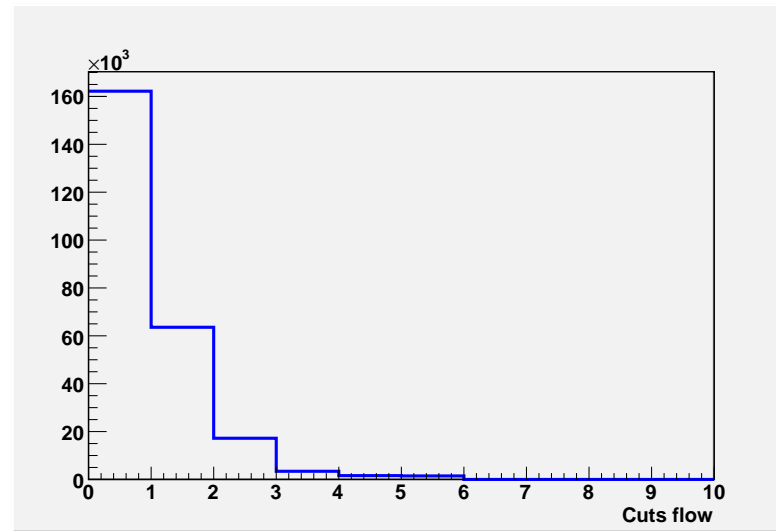


- The dark violet area within $-3.2 < \eta < -1.5$ and $\pi/2 < \phi < 0$ shows the missing quadrant on the HEC C side. The other small dark violet area is a FEB missing on HEC A



Event selection cuts flow

- ▶ Plot shows how many events are left after each main cut applied in the event selection

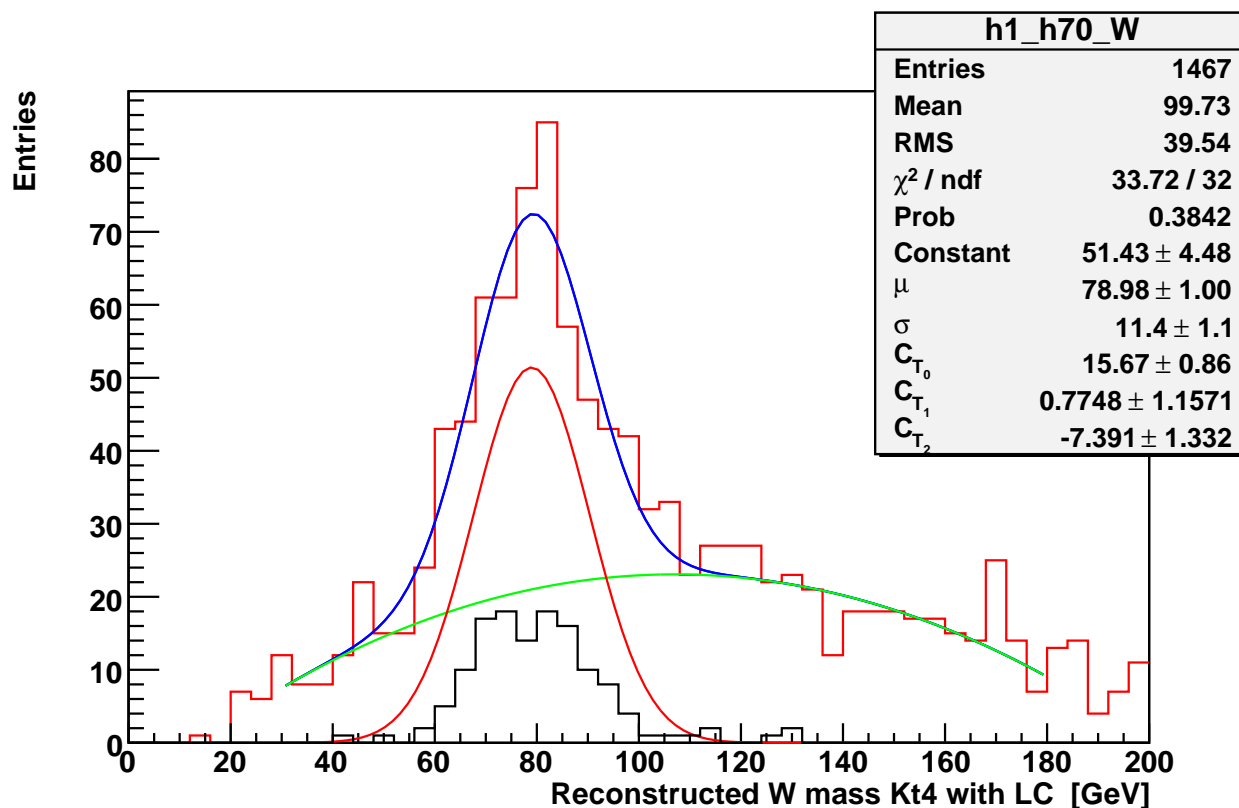


- Bin1: Total number of events
- Bin2: $\approx 40\%$ of the events remain after the missing HEC quadrant cut,
- Bin3: $\approx 27\%$ of events remain after requiring to have 3 jets with $p_{\perp} > 40$ GeV and 1 jet with $p_{\perp} > 20$ GeV
- Bin4: $\approx 20\%$ of events remain after the requirement to have a combination of 4 good jets: 2 B-jets and 2 light-jets
- Bin5: $\approx 47\%$ of the events remain by asking to have a good e or μ
- Bin6: $\approx 92\%$ of the events remain after the MET cut
- ▶ Final selection efficiency using the P_T balance method $\approx 1\%$
- ▶ Most of the events lost in Bin2 (quadrant missing) and Bin4 (jet B-tag)



W mass with k_T 4 jets and LC

- ▶ The plot shows the reconstructed W-mass obtained using k_T with parameter $R = 0.4$ and LC

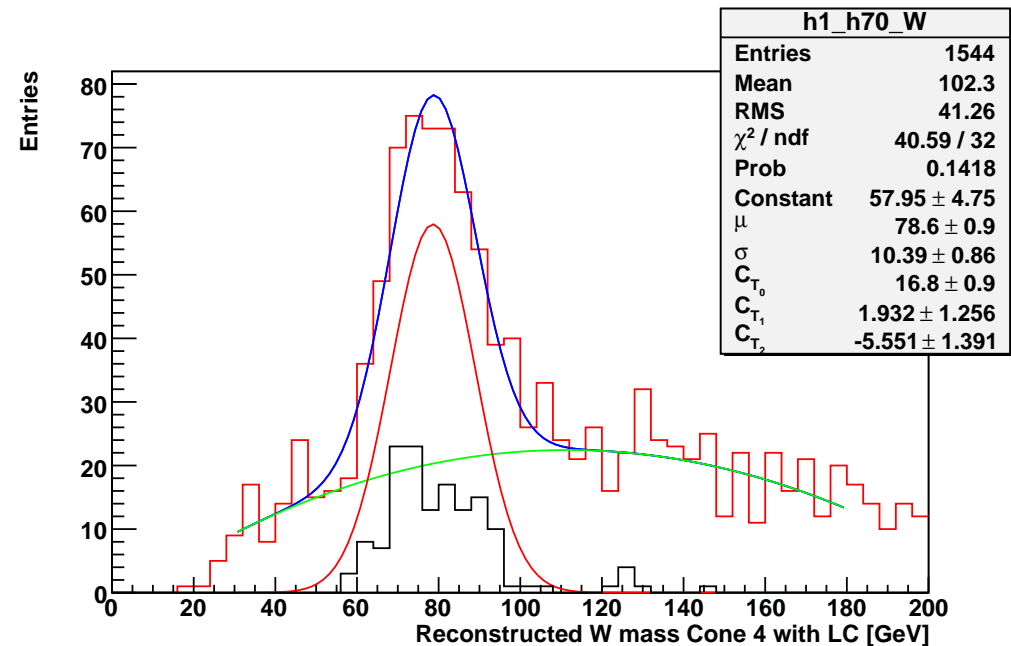
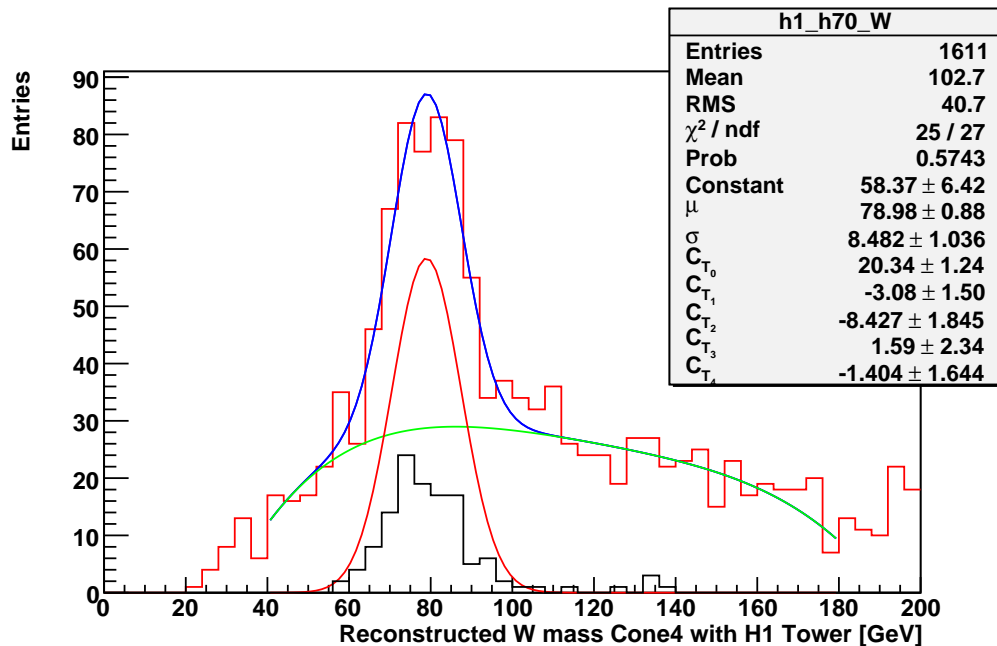


- ▶ Even though the final statistic is low a good W mass measurement can be obtained using k_T 4 jets and LC
- ▶ There is still some inefficiency in the truth-matching jets procedure (black distribution in the figure)



W mass with Cone4 jets

- Plots show the reconstructed W-mass distribution obtained using Cone4 with H1 Tower jets (left plot) and LC Topo-jets (right plot)

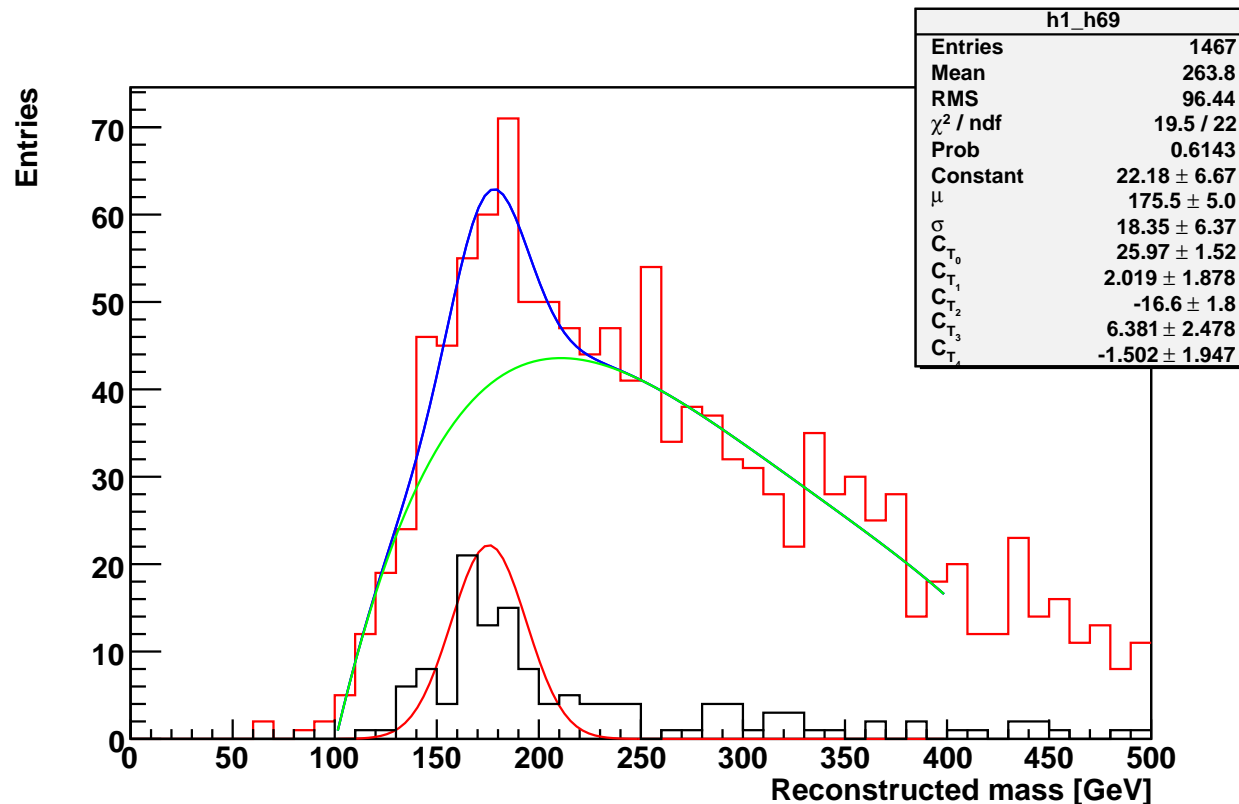


- Comparable results are obtained for the W mass measurements using Cone4 H1 Tower jets, Cone4 LC Topo jets, and also using k_T 4 LC jets



Top mass with k_T 4 jets and LC

► Reconstructed Top-mass k_T 4 with LC

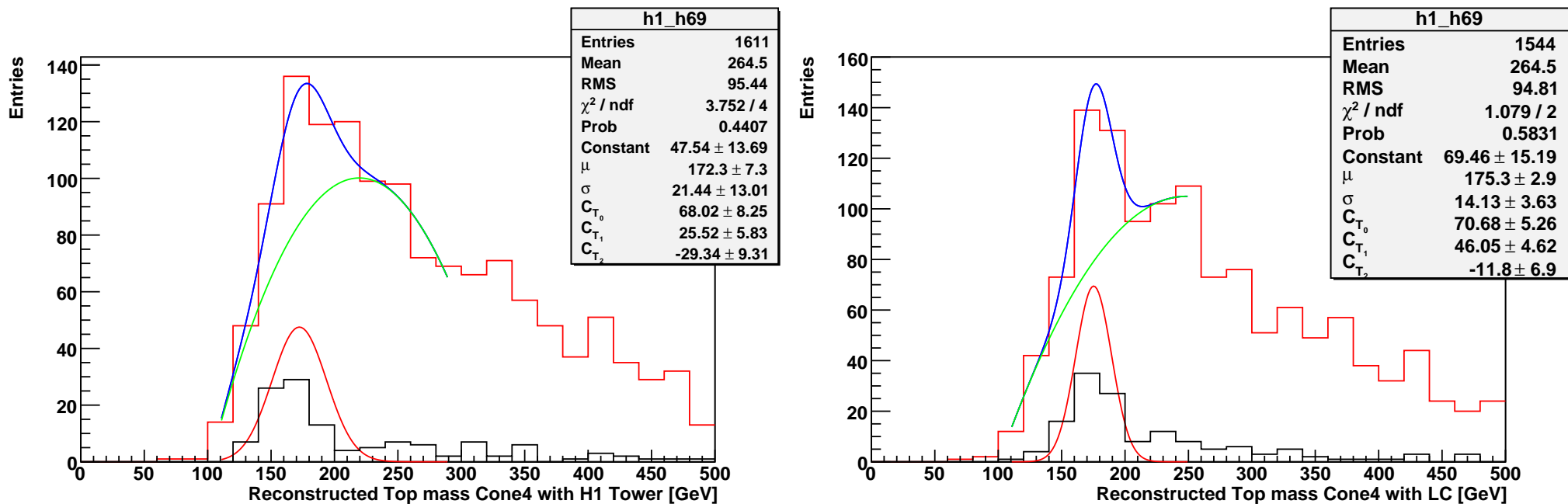


- The statistic is low, but a good Top mass measurement can be obtained using k_T 4 jets LC and the P_T balance method
- Also here we see the inefficiency in the truth matching procedure (black distribution in the figure) to be fixed



Top mass with Cone4 jets

- Reconstructed Top mass obtained using Cone 4 with H1 Tower jets (left plot) and LC Topo-jets (right plot)



- The top mass distributions obtained with the two Cone 4 jets considered are less good than the one obtained with k_T 4 jets



Conclusions

- ▶ Comparable results can be obtained using jets with H1 calibration and jets with LC. Even though the jets with LC have a 5% offset at higher jet energy value. This is going to be fixed in the next release
- ▶ With the P_T balance method is possible to achieve good W mass and top mass measurements
- ▶ Though the efficiency of the method is very LOW. Because of the HEC quadrant missing, and because the B-tag??!
- ▶ More investigations are needed.
- ▶ One thing to do is to use the dataset 105200 with the HEC quadrant back and check the differences

