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The Compact Muon Solenoid Experiment

CMS Note

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Studies of the response of the HCAL system

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Abstract

We investigate the HCAL response ...

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Contents

1 Introduction

It is important to study things like this.

2 Previous Studies

2.1 CMS Studies

A previous CMS study is [1] .

3 Software and Event Samples

`ORCA_4_4_0` and the ntuple maker of the JetMET Physics Group were used to produce ntuples from simulated events of the CMS experiment. We use PYTHIA double pion events and struggling with populating our private Objectivity user federation. No pile-up for the moment.

4 Tau Jet Response and Correction of Tau Jets

Figures 1 , 2 , 3 and 4 show the response of the $ECAL + HCAL$ system to τ jets.

Figure 3 shows that increasing the cone size from 0.5 to 0.7 we introduce channel dependence. It may be because of picking up false energy coming from noise.

Figure 5 shows the correction as a function of the reconstructed τ jet energy.

Figure 6 demonstrates, that the correction has no η dependence on the scale we are insvestigating it now.

Figure 7 shows the result of fitting of a second order polinomial to the correction plot. We have bad resolution for τ jet energy less than $60GeV$ thus we fitted the correction above this threshold.

Figure 8 shows the average shift of the first level missing E_T.

Figure 9 shows the average shift and Figure 10 shows the resolution of the second level missing E_T as a function of the generated missing E_T with and without correction. τ jets were corrected by response, non τ jets which have $E_T > 30GeV$ by Silvia's no pile-up corrections and the rest of the towers also by Silvia's no pile-up jet energy corrections at $30GeV$.

Figure 11 shows Higgs mass distributions without correction.

Figure 12 shows Higgs mass distributions with corrected τ jets .

Figure 13 shows Higgs mass distributions with corrected missing E_t .

Figure 14 shows Higgs mass distributions when both τ jet and missing E_t corrections are applied.

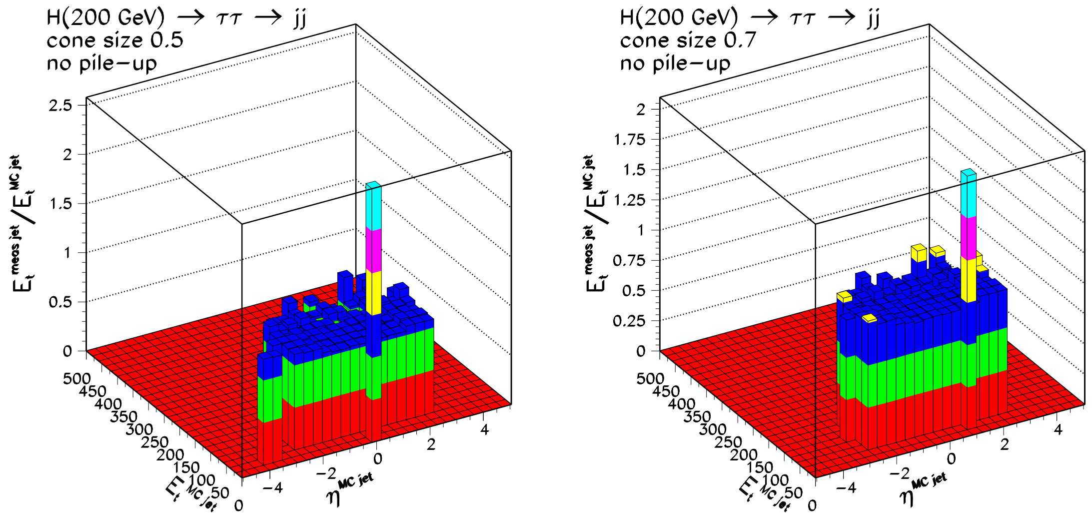

Figure 1: τ jet E_T response for 200 MeV Higgs with 2 cone sizes.

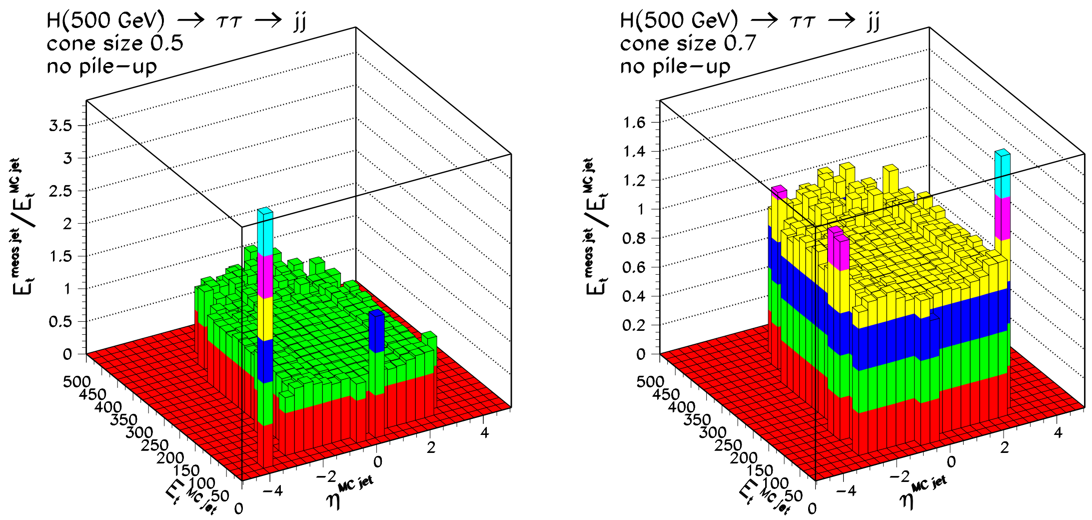

Figure 2: τ jet E_T response for 500 MeV Higgs with 2 cone sizes.

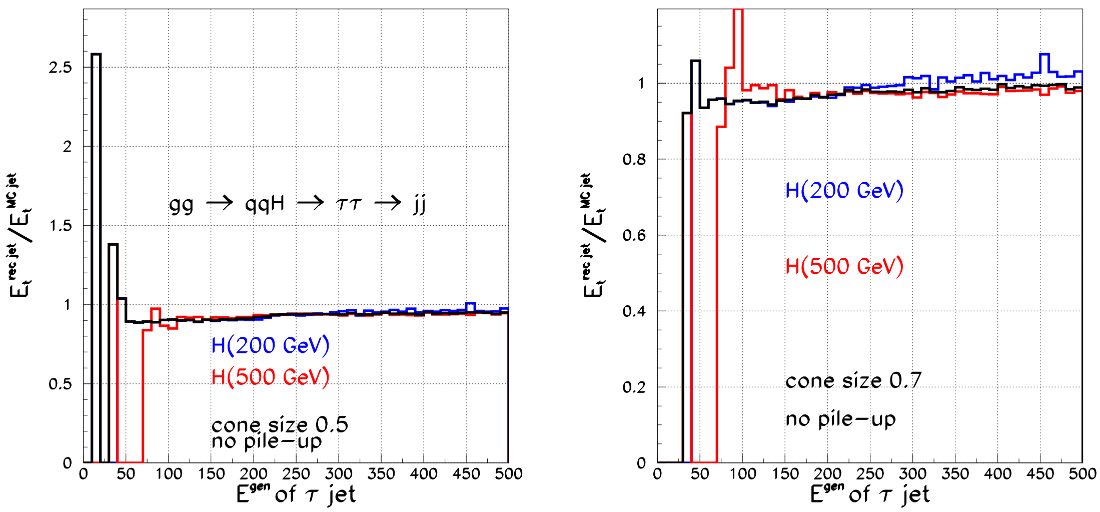

Figure 3: τ jet E_T response for 2 cone sizes.

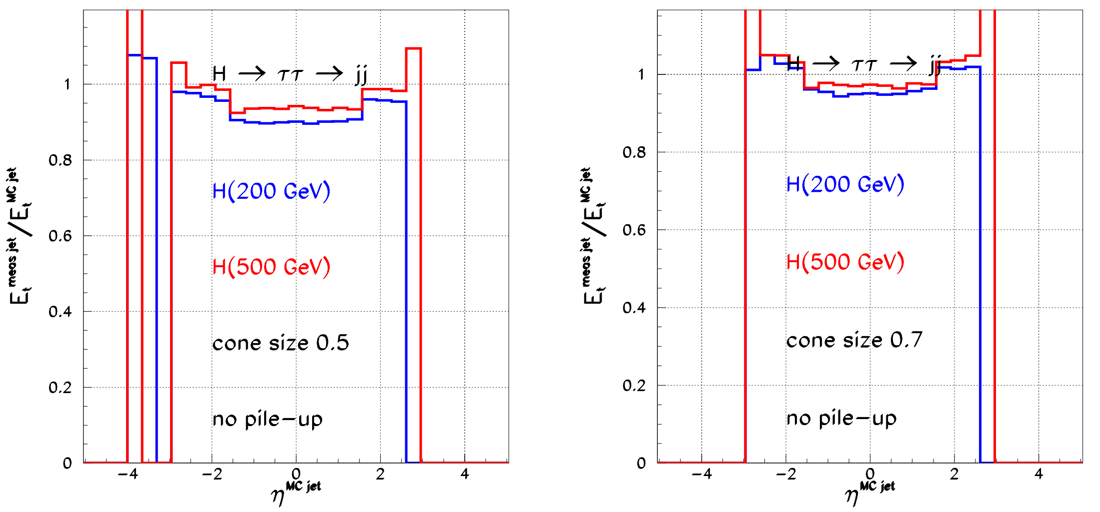

Figure 4: τ jet E_T response for 2 cone sizes.

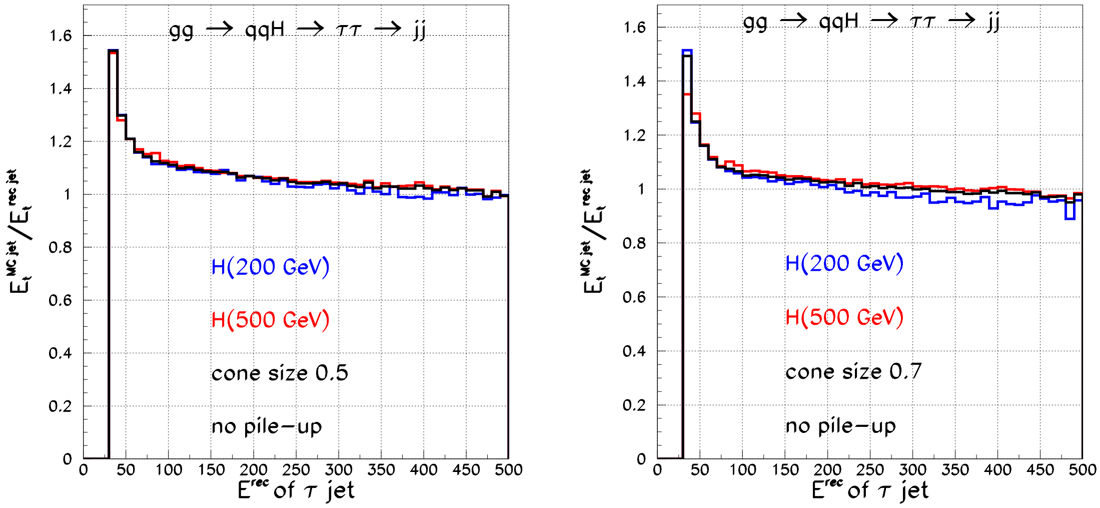

Figure 5: τ jet E_T response for 500 MeV Higgs with 2 cone sizes.

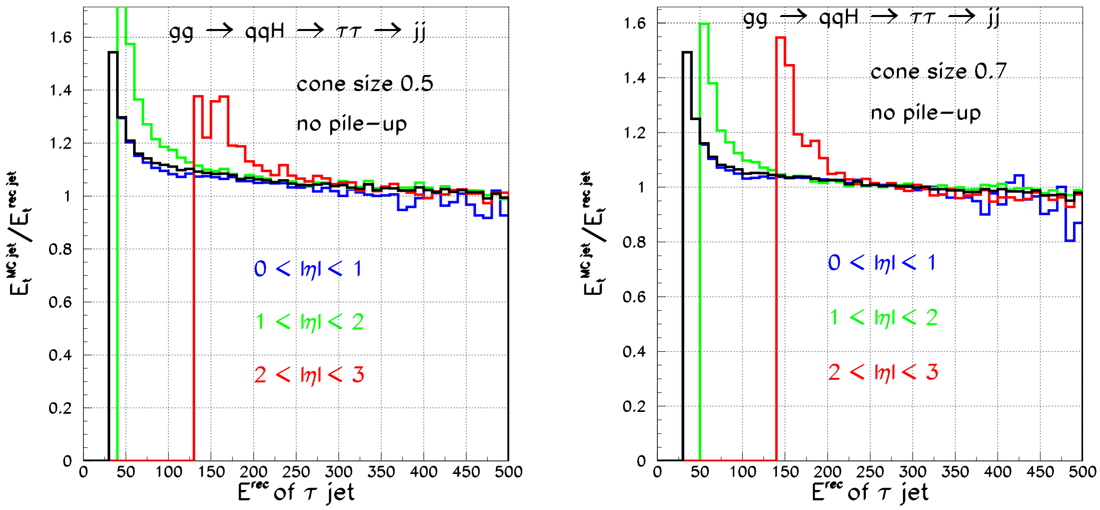

Figure 6: τ jet E_T response for 500 MeV Higgs with 2 cone sizes.

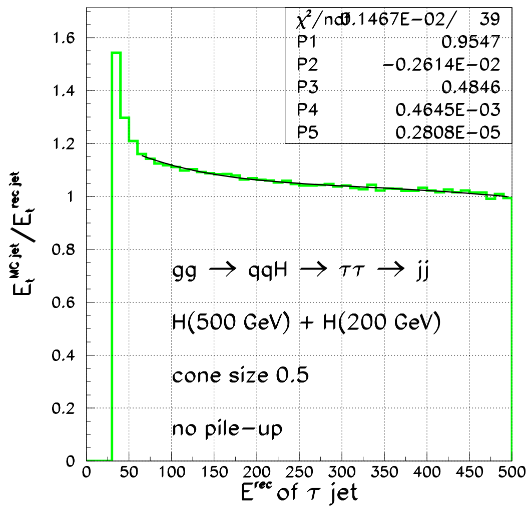

Figure 7: τ jet E_T response for 500 MeV Higgs with 2 cone sizes.

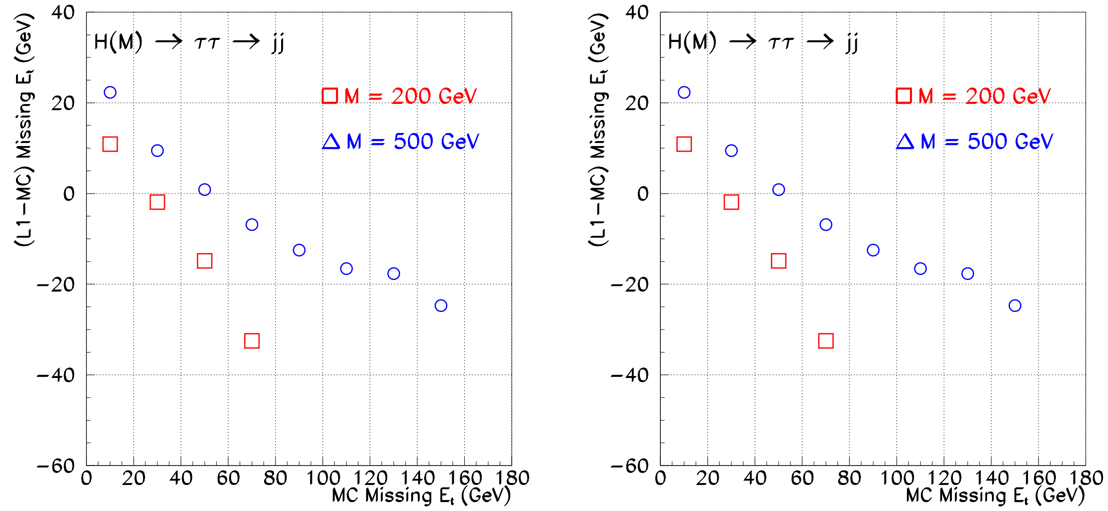

Figure 8: First level missing E_T shift for 2 Higgs masses. It is drawn twice, the second will be replaced by resolution.

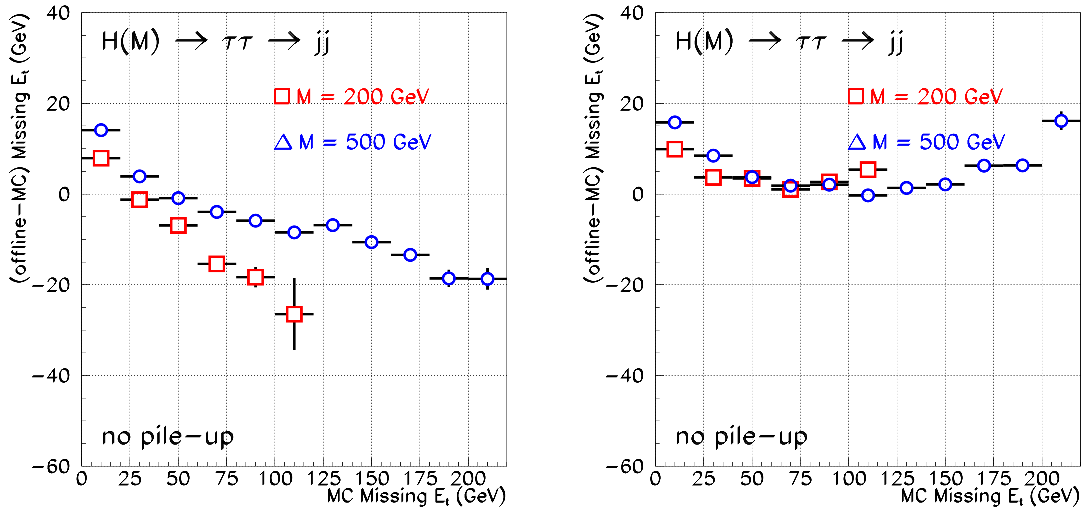

Figure 9: Second level missing E_T shift for 2 Higgs masses. The left figure is without correction, the right one is with correction. τ jet, non τ jet and tower energy corrections combined.

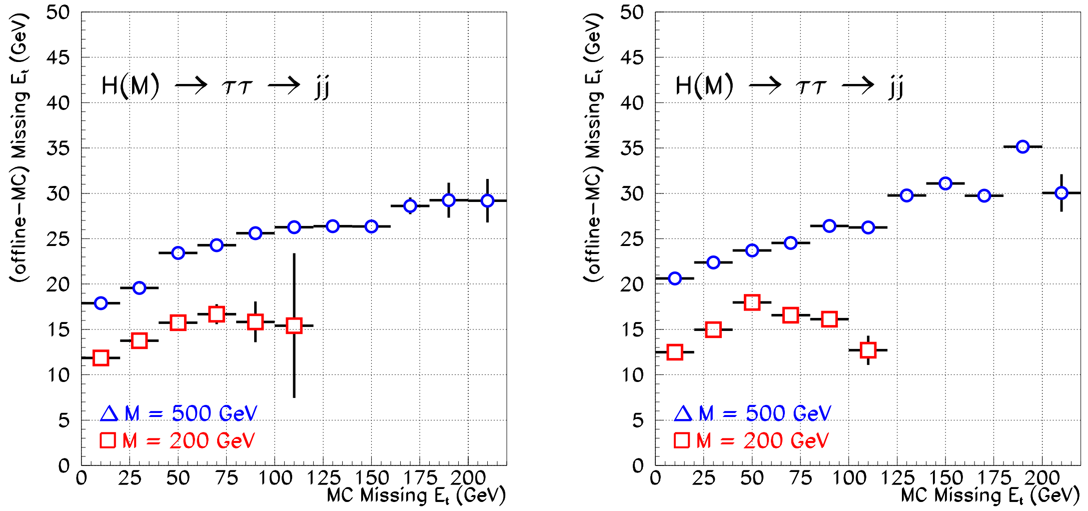

Figure 10: Second level missing E_T resolution for 2 Higgs masses. The left figure is without correction, the right one is with correction. τ jet, non τ jet and tower energy corrections combined.

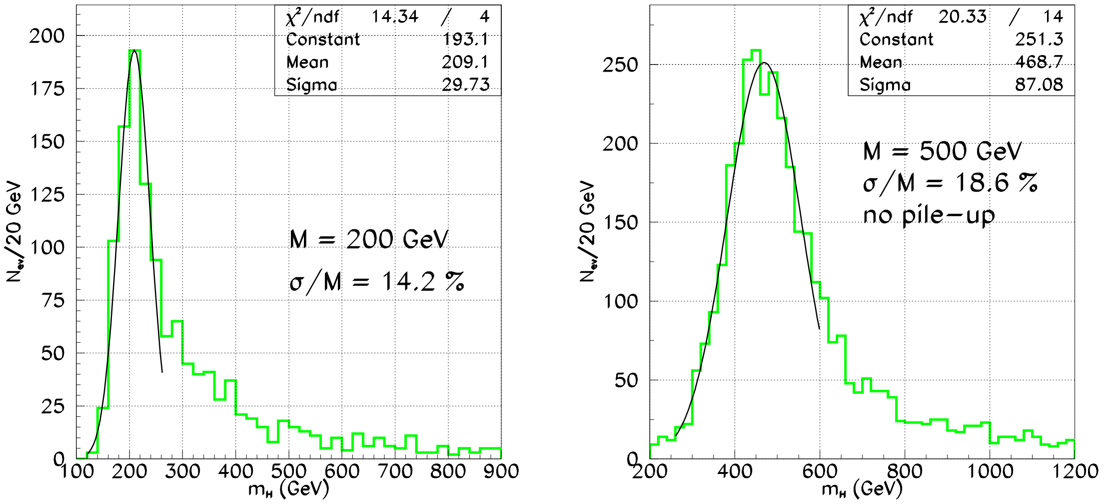

Figure 11: Recontructed mass of Higgs bosons decaying to τ jets for two nominal mass values, without any corrections applied.

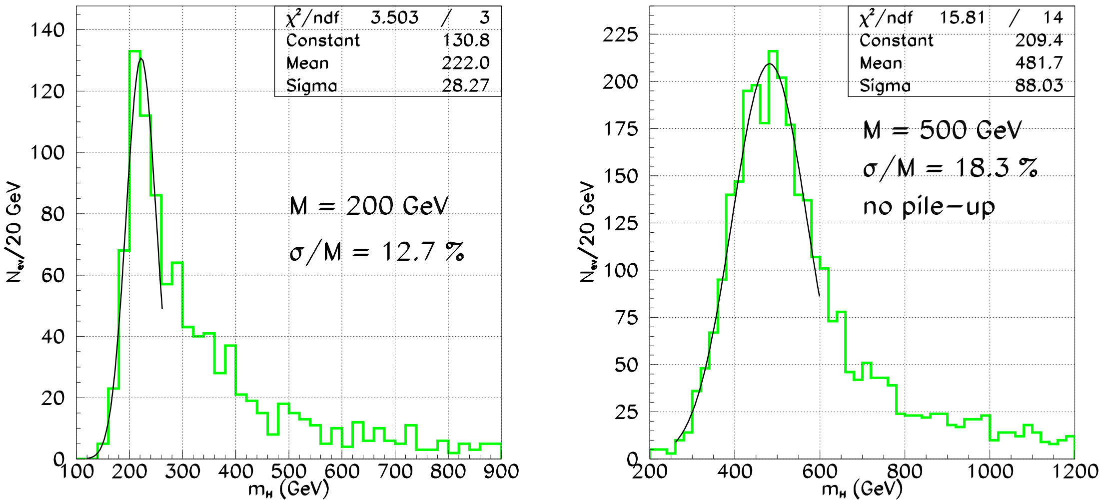

Figure 12: Recontructed mass of Higgs bosons decaying to τ jets for two nominal mass values, with corrected τ jets.

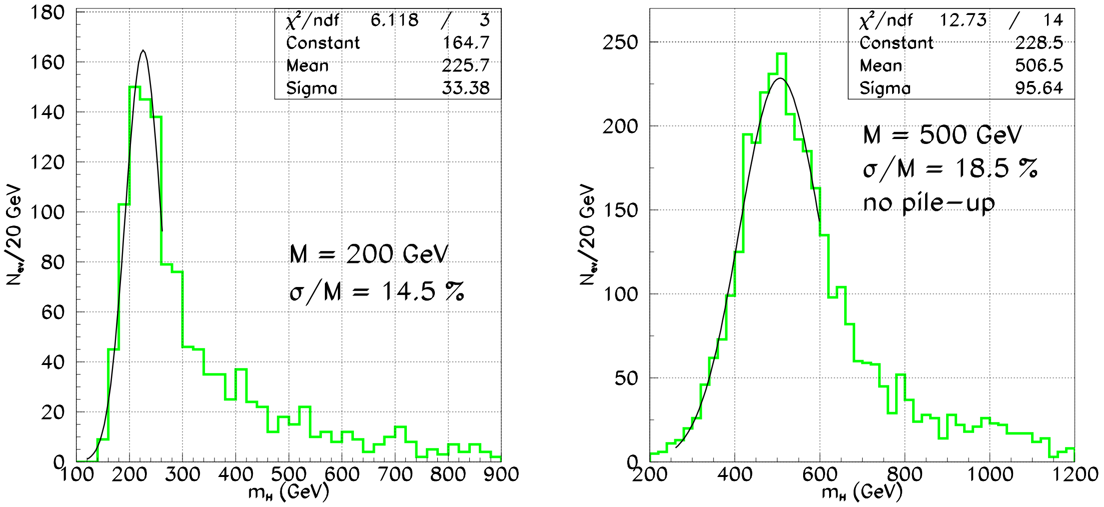

Figure 13: Recontructed mass of Higgs bosons decaying to τ jets for two nominal mass values, with corrected missing E_t.

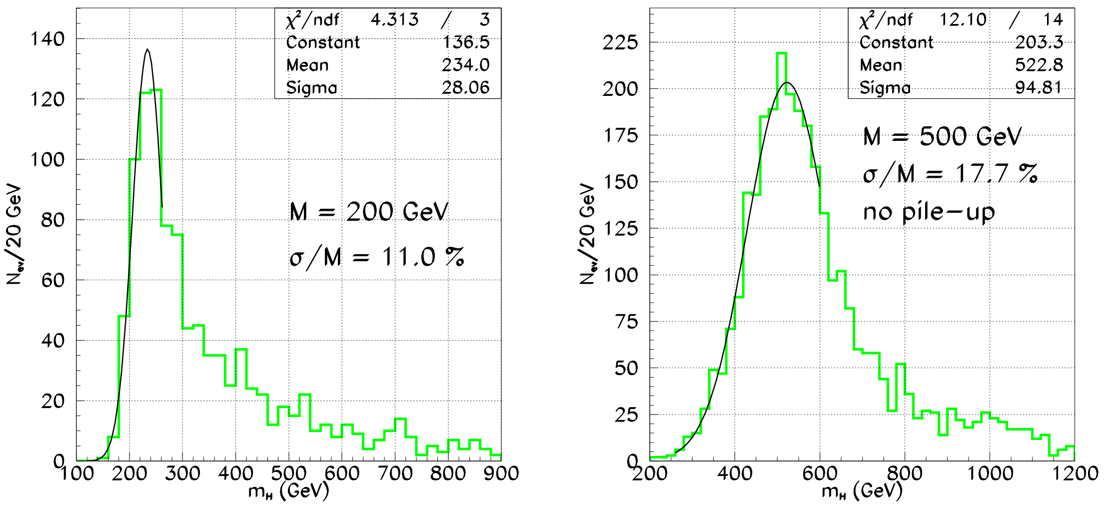

Figure 14: Recontructed mass of Higgs bosons decaying to τ jets for two nominal mass values, with correcting both missing E_t and τ jets.

The correction is not satisfactory. Studying τ jets in the central region we found that it is also necessary to take into account the electromagnetic/hadronic energy portions of the τ jets.

Figure 15 shows the relative energy of the neutrino with respect to the τ energy for two Higgs masses. It also has the energy distribution of charged pions included in the τ jets. These distributions show, that the final state composition of τ jets is different for the two $Higgs$ masses in a definite phase space region, so it is not enough to calculate correction factors only from phase space parameters .i.e. from jet E_t and η .

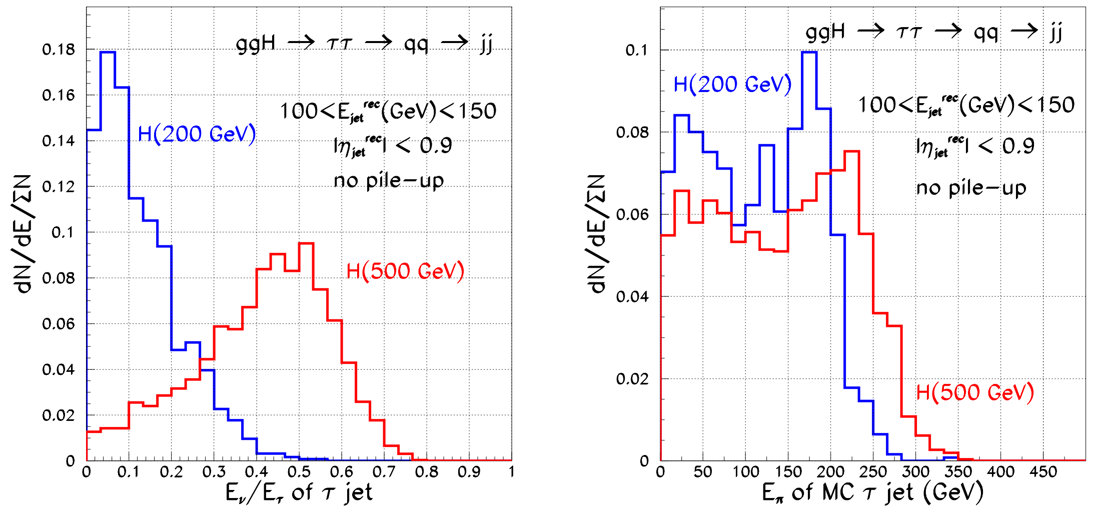

Figure 15: The relative energy of the neutrino with respect to the τ energy (left figure) and the energy distribution of charged pions included in the τ jets.

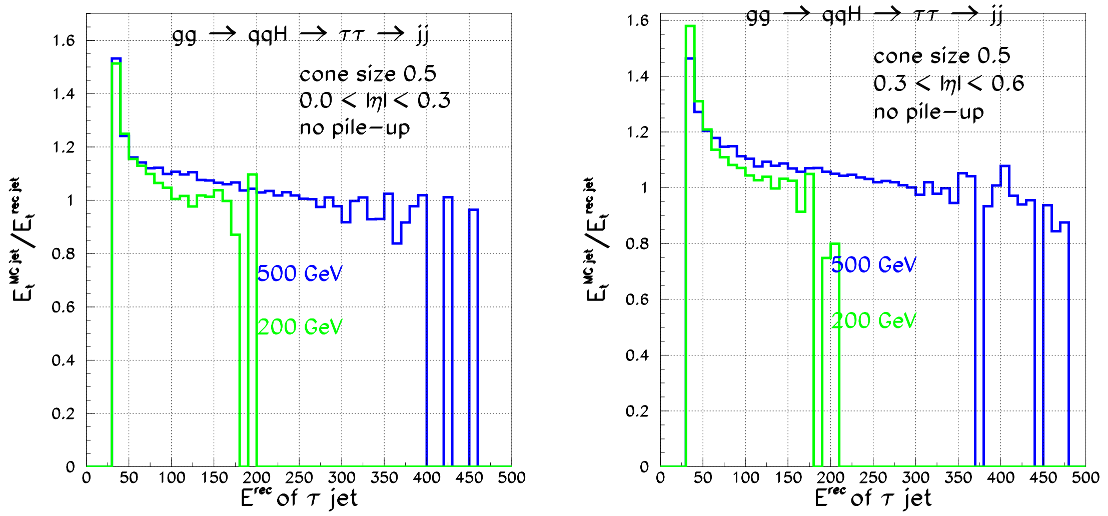

Figure 16: The necessary correction of τ jets in two eta regions, for a specific reconstructed energy range.

5 Conclusions

That's all folks.

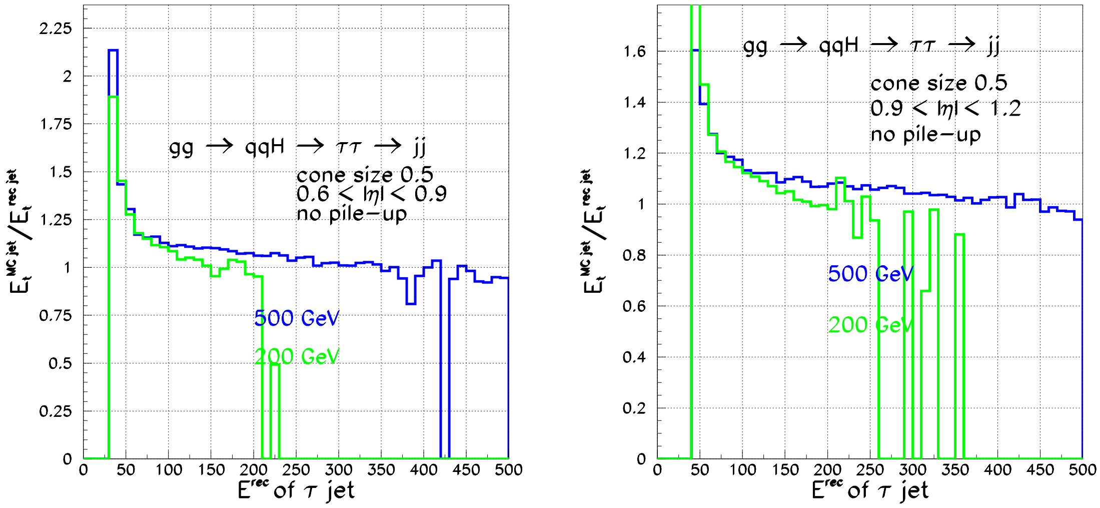

Figure 17: The necessary correction of τ jets in two eta regions, for a specific reconstructed energy range.

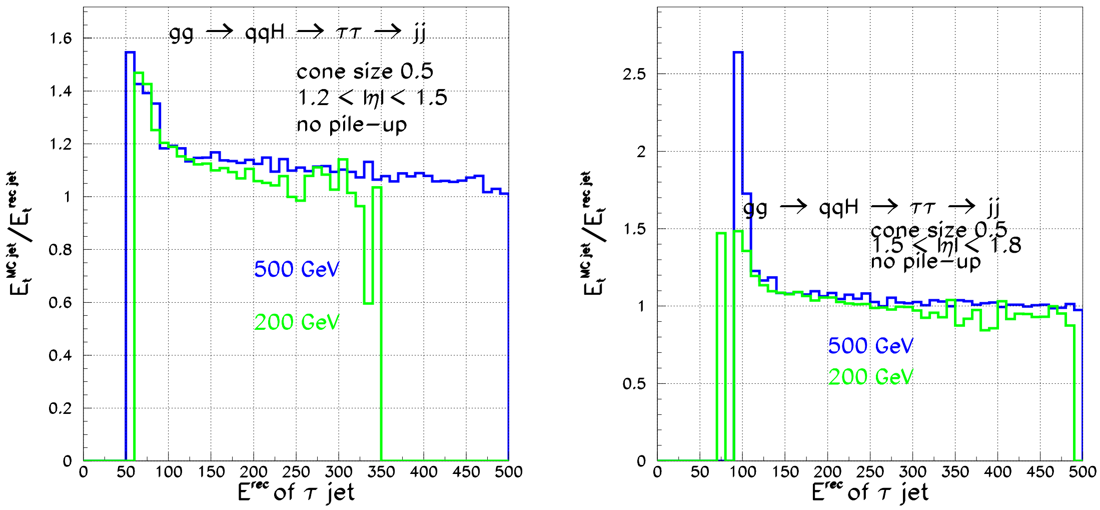

Figure 18: The necessary correction of τ jets in two eta regions, for a specific reconstructed energy range.

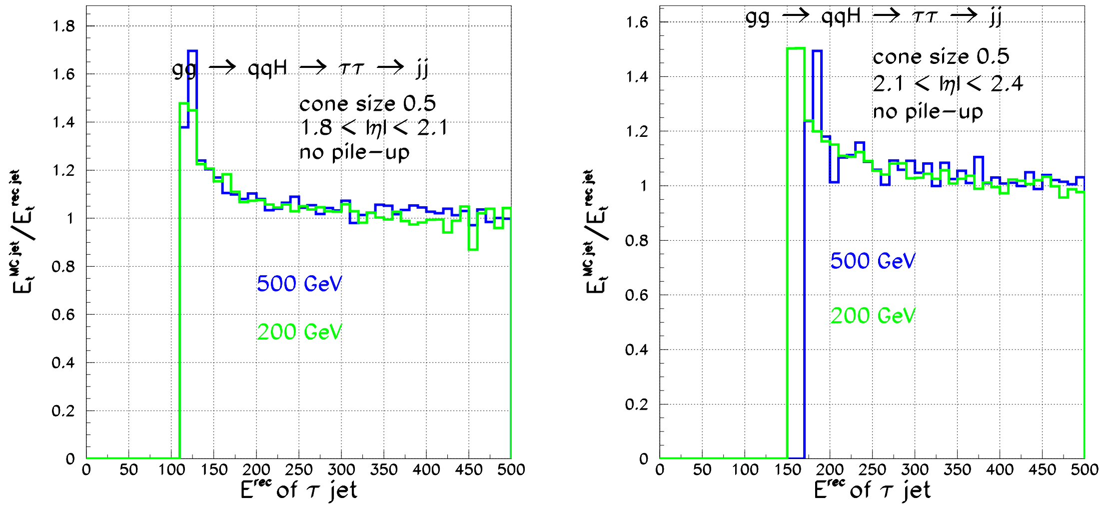

Figure 19: The necessary correction of τ jets in two eta regions, for a specific reconstructed energy range.

Acknowledgements

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References

[1] **hep-ex/0007045**, V.V.Abramov, ..., S. Kunori et al., The CMS-HCAL Collaboration *"Studies of the response of the Prototype CMS Hadron Calorimeter, Including Magnetic Field Effects, to Pion, Electron and Muon Beams"*.