Jet Energy Scale determination at DØ

Christophe Royon
DAPNIA-SPP, CEA Saclay and Fermilab

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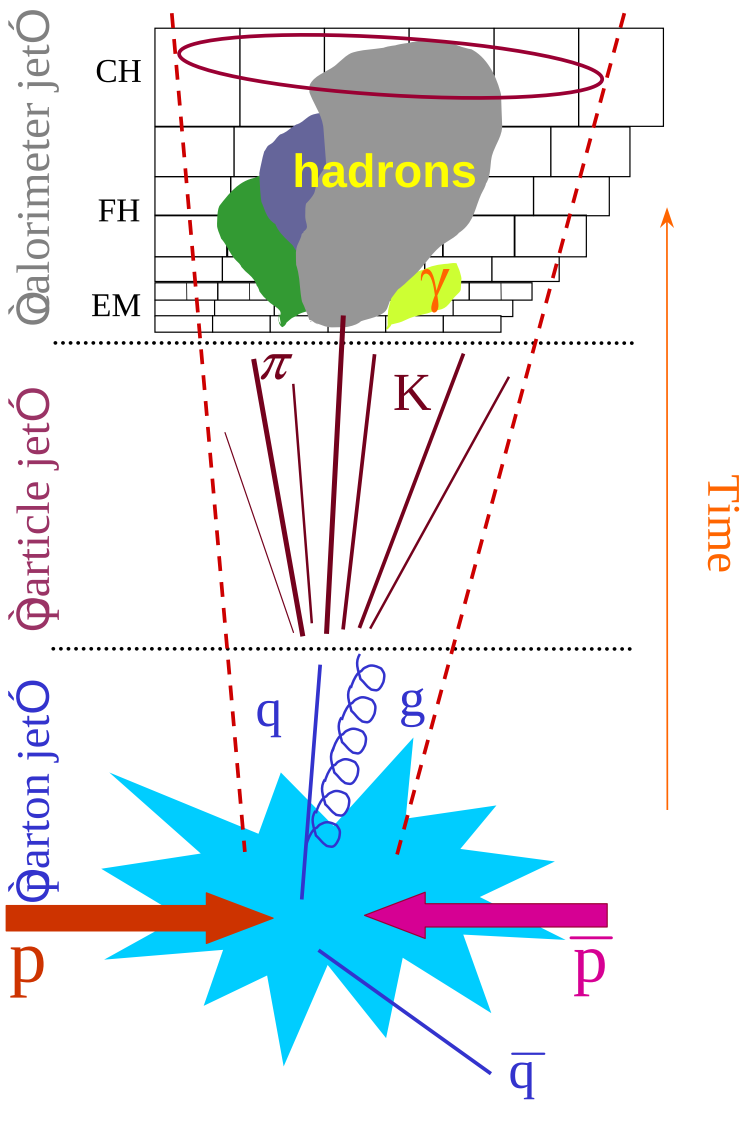
- Aim: discuss different aspects of p17 JES relevant for top mass determination
- How do we get JES in DØ ?
- Different steps: offset, showering, response

Jets at DØ

Correct jets down to particle level (jets are a collection of towers in the calorimeter, 0.5 and 0.7 jet cones are used)



Jets energy scale determination

- $$E_{jet}^{corr} = \frac{E_{jet}^{uncorr.} - Off}{Show \times Resp}$$

- Off: offset corrections, related to uranium noise, pile-up..., Determined using zero-bias and min. bias data

- Show: Showering corrections, takes into account the energy emitted outside of jet cone because of detector, dead material..., of course, does not take into account physics showering outside the jet cone, particles outside the cone

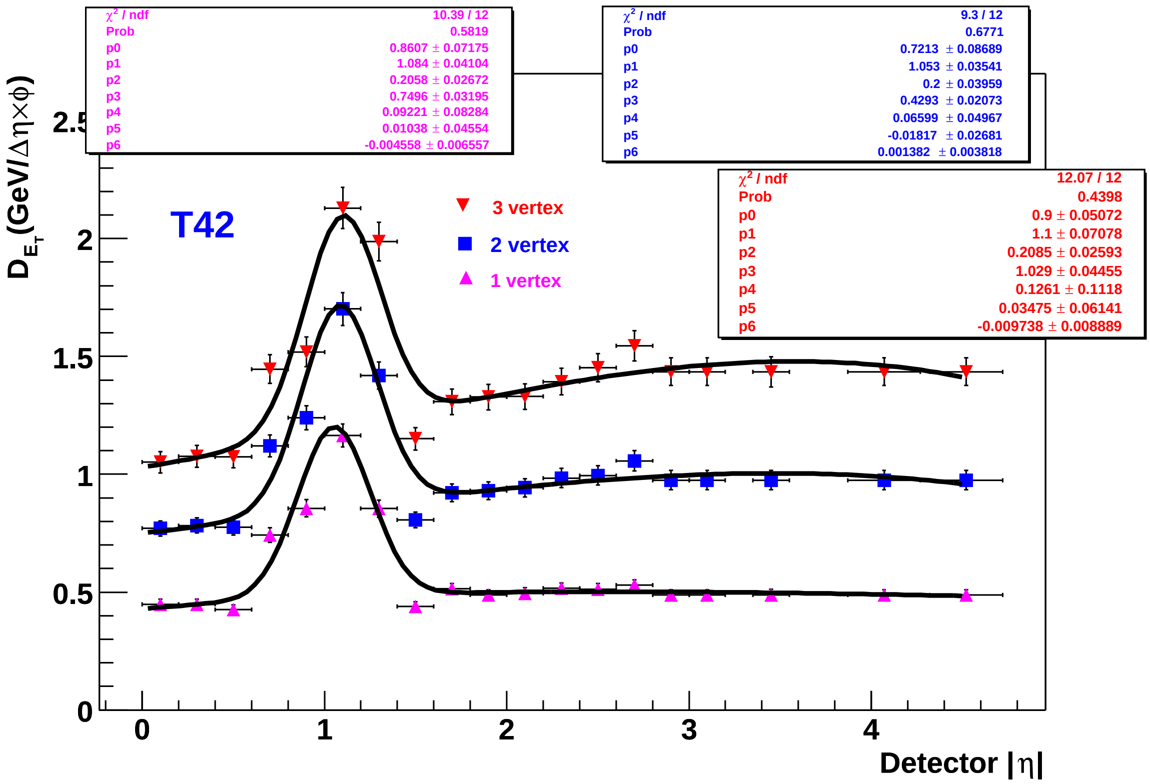
- Resp: Jet response, obtained using p_T balance in $\gamma+$ jet events, cross check using $Z+$ jet event

Offset determination

- Definition: Energy not associated with the hard scattering
- Contributions: Electronic noise, uranium noise, pile-up, energy from additional interactions, NB: Shaping time at DØ calorimeter preamplifier is longer than the bunch crossing time so it is possible that before the signal from an earlier bunch crossing dies a new signal is formed and it sits over the top of the previous signal
- Perform the study as a function of instantaneous lumi, number of vertices
- Determine the energy density for zero-bias and min bias events and special runs taken without zero suppression for calo

Offset determination

Energy density as a function of η and Φ for min. bias events for different numbers of reconstructed vertices

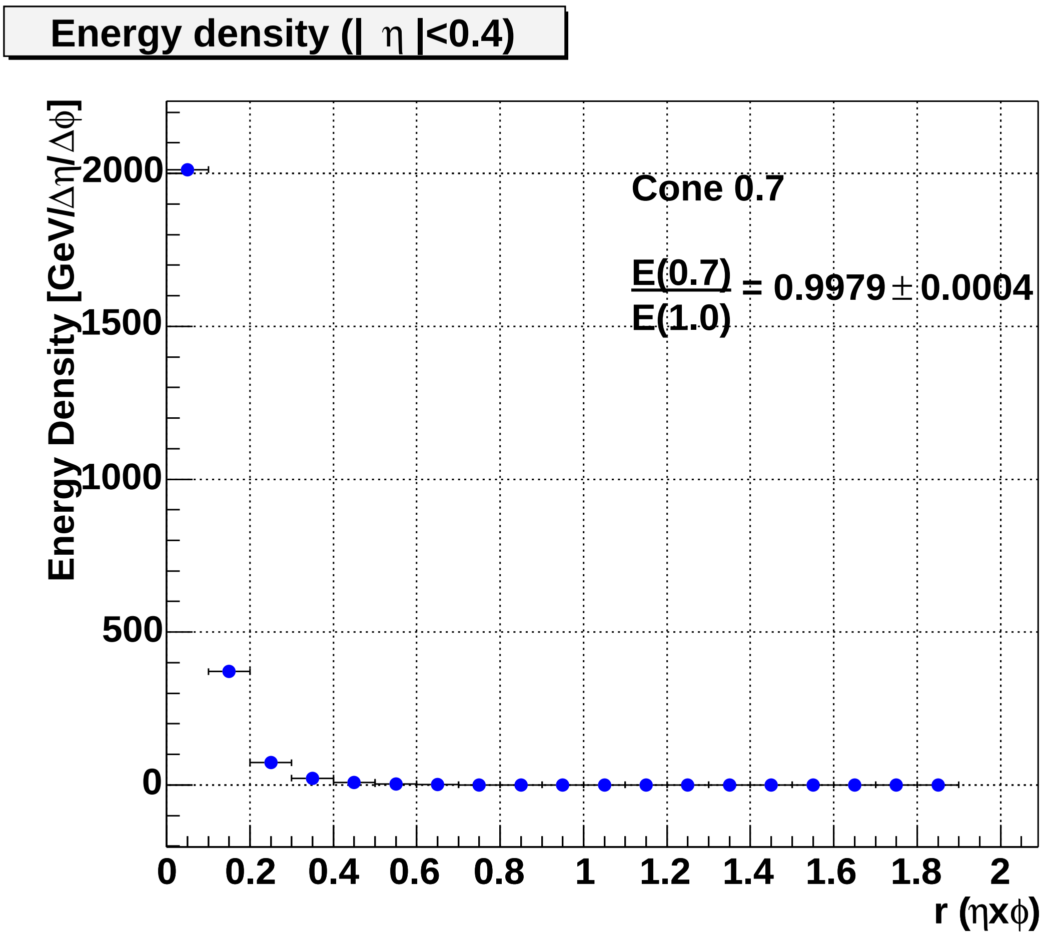


Showering determination: data based method

- First step: Compute the energy density in the calorimeter in steps of 0.1 in Φ and η around the jet direction as a function of the distance from the jet
- Subtraction of a base line in energy density due to noise, underlying events...
- Computation of showering corrections: amount of energy outside the jet cone of 0.5 or 0.7
- Last step: Subtract the showering effects in Monte Carlo (Pythia/Herwig) at particle level due to physics effects (particle emitted outside the cone...) (NB: showering corrections should take into account only effects of dead materials...)

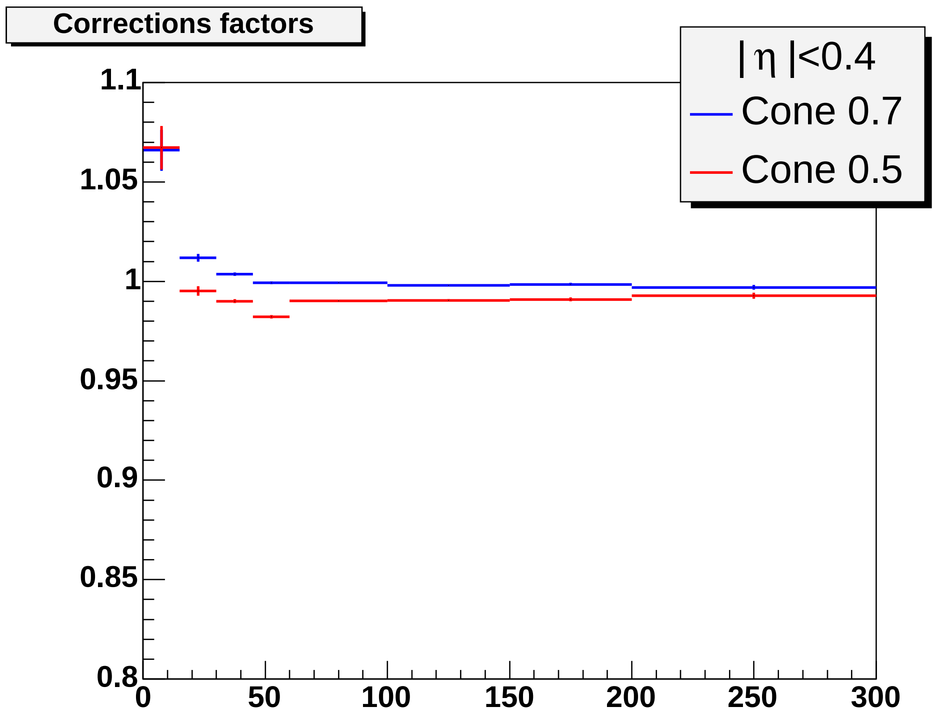
Showering determination: data based method

Energy density distribution as a function of the distance from the 0.7 cone jet for a jet p_T between 100 and 150 GeV



Showering determination as a function of p_T

- Determine the showering corrections as a function of jet p_T for central jets ($|\eta| < 0.4$)
- Cross-check: use directly MC method, where we know how much energy is deposited in each cell by each particle



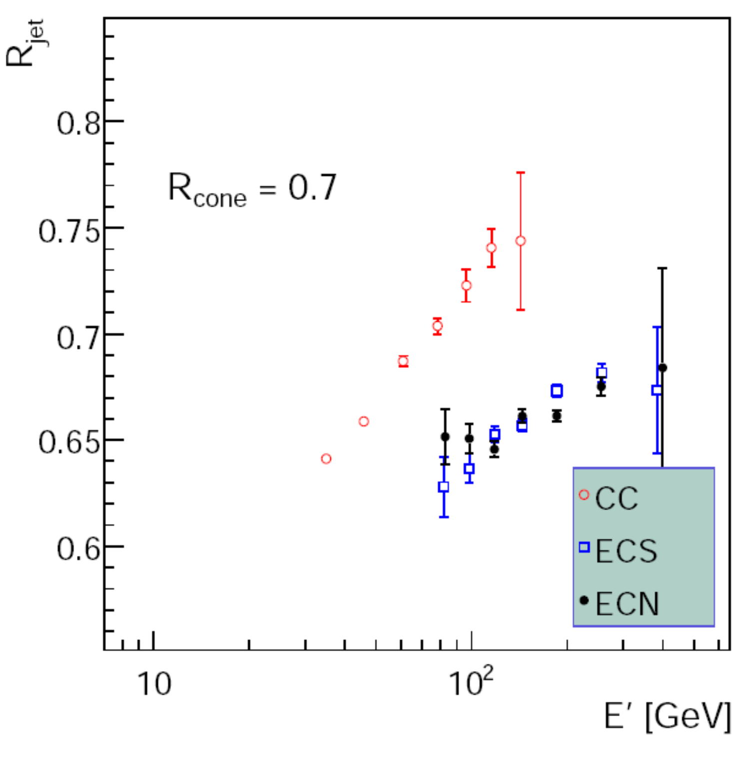
Jet response in CC and EC: Method

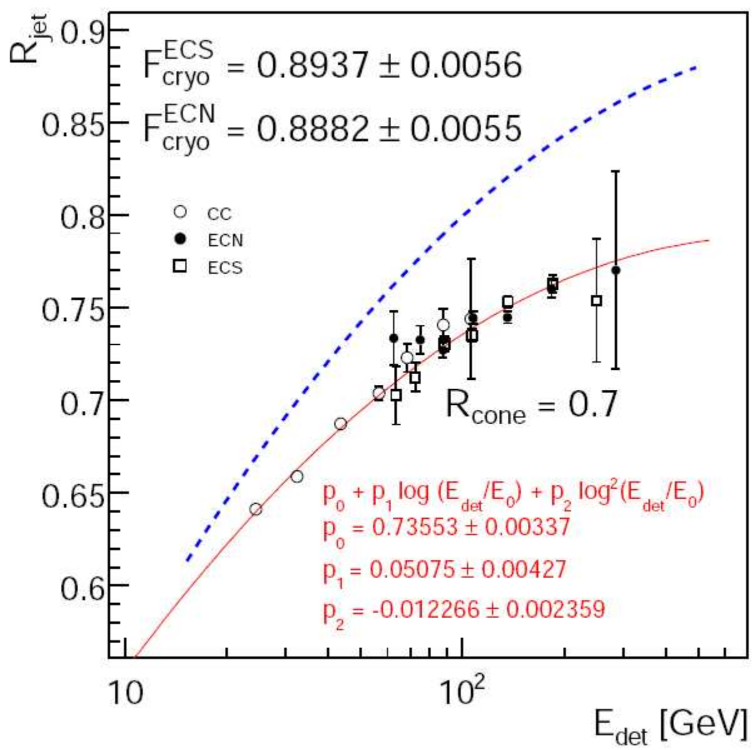
- Study jet response using MPF method: Use γ+jet events
- Theoretically: exact balance between photon and recoil jet: $E_{T\ \gamma} + E_{T\ recoil} = 0$
- In practice: take into account response of EM and HAD detectors: $R_\gamma E_{T\ \gamma} + R_{recoil} E_{T\ recoil} = -MET$
- After EM calibration ($R_\gamma = 1$): $R_{recoil} = 1 + \frac{n\dot{M}ET}{E_{T\ \gamma}}$ (Projection on the photon direction)
- For very nice events: 1 photon and 1 jet, back-to-back, $E_{T\ recoil} = E_{T\ jet}$

Jet response

Perform the study as a function of

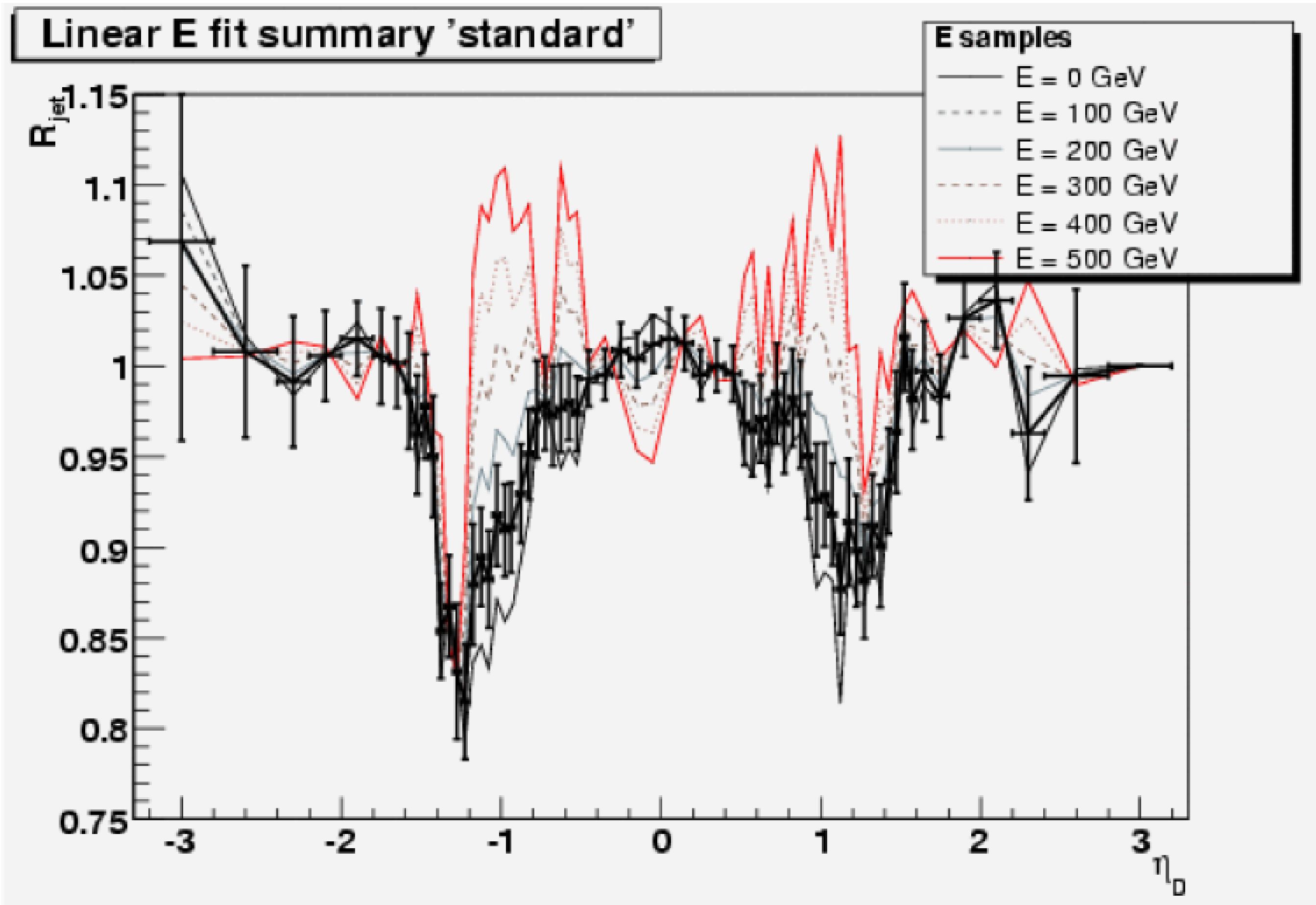
$E' = E_{T\ \gamma} cosh\eta_{jet}$: Less sensitive to jet energy resolution, mapping to go from E' to E_{jet}





Jet response in ICR

- Jet response in ICR use one jet in CC, and one in ICR using dijet p_T imbalance method
- Possible to go to lower p_T using γ+jet

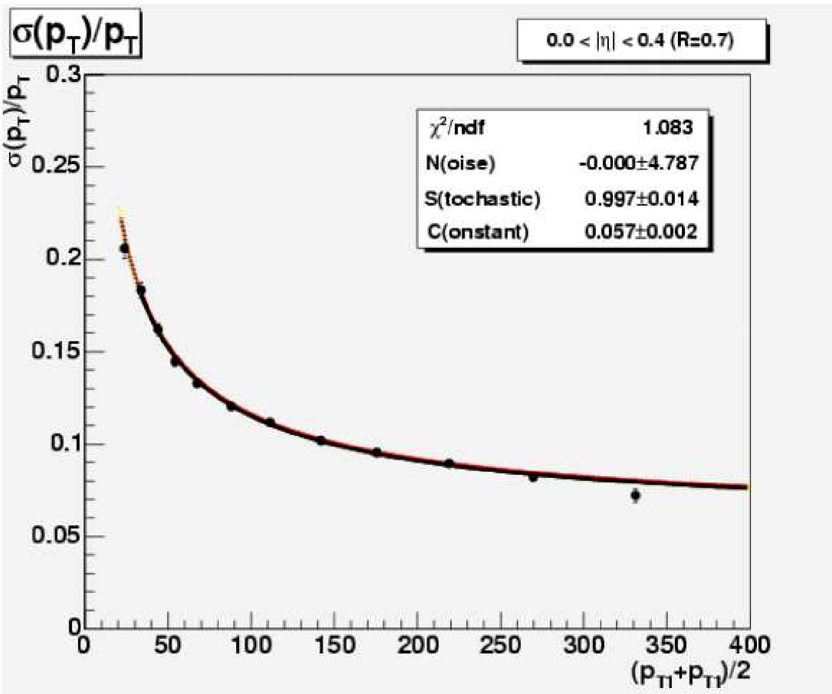


Systematic studies

- We are using directly data to extract JES: many systematics coming from Ids
- Vary photon Id cuts
- Vary EM scale: especially differences between EM scale for electron (coming from study of Z peak), and photons
- Vary event selection: back-to-back properties related to $\Delta\Phi$ cut between photon and jet, related to sample purity
- Another issue: low E_T bias: Effect of the jet reconstruction p_T cut on response, missing jets due to resolution effects (studied by lowering jet threshold...)

Jet p_T resolution

- Jet p_T resolution using the asymmetry method in dijet events
  $A = |p_{T1} - p_{T2}|/(p_{T1} + p_{T2})$
- Cross check using $\gamma+$ jet



Closure tests - Data/MC comparisons

- Closure tests using hemisphere method and p_T balance between jets and photon: the idea is to check if all corrections lead to closure in MC and data (in progress)
- Closure tests using dijets for instance one jet in CC and another one in EC
- Data-MC comparison: two issues: compare JES corrections in data and MC, degrade MC to take into account resolution and jet reconstruction inefficiencies

Conclusions

- All JES related topics presented and discussed: offset, response and showering, as well as closure tests
- Systematic uncertainties: in progress, goal being to reach run I level of systematics by the end of the year (about 2% in CC)
- Top mass: Important to study data/MC comparisons since the relative uncertainty plays a role in top mass determination (in porgress)
- Additional constraint to top mass determination: W mass determination, fixes an absolute scale for JES