In situ mass calibration of Large-R jets via Forward Folding method other tt events at 13 TeV

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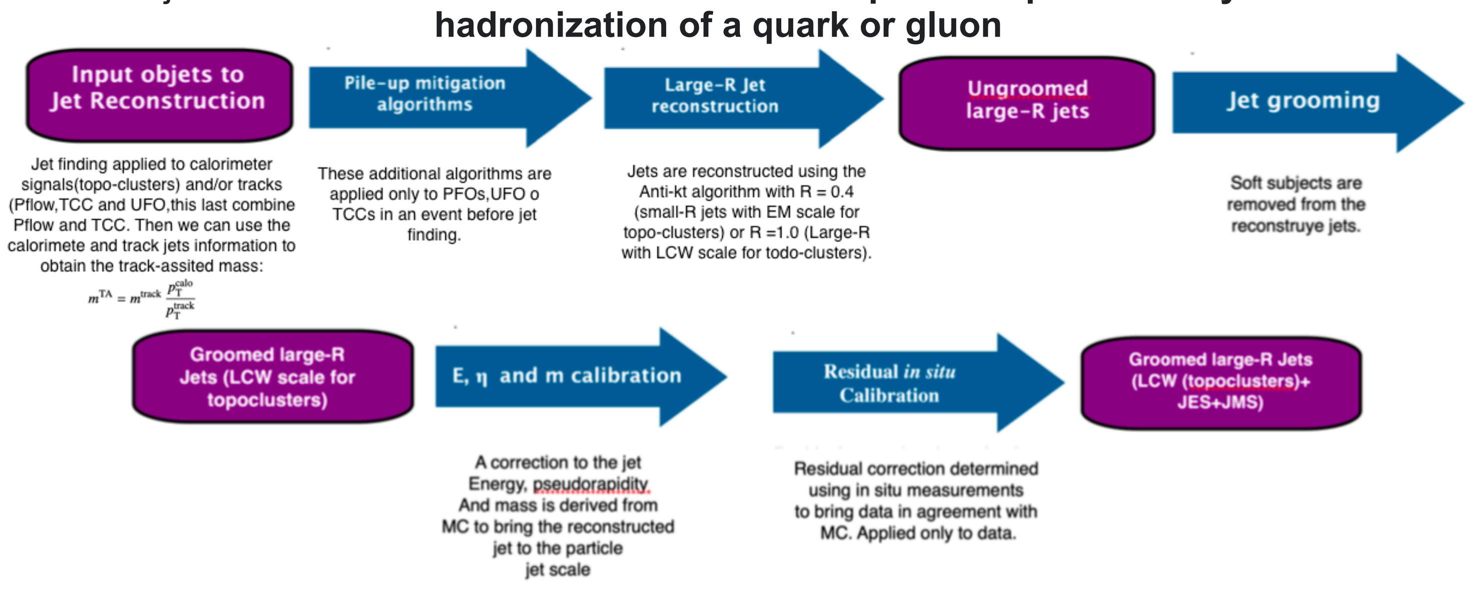
A jet is **a narrow cone of hadrons and other particles produced by the hadronization of a quark or gluon**



FF method

- A general transformation is applied to variable X:

$$X_{reco}^{folded} = X_{reco}s + (X_{reco} - X_{true}R)(r - s)$$

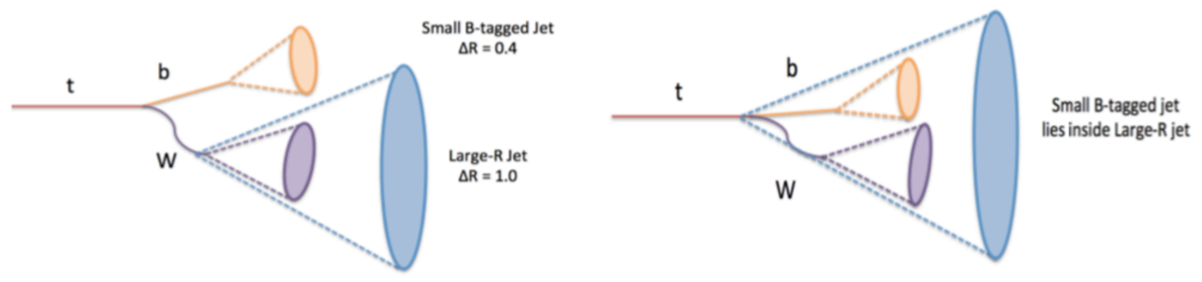
  where R is simulated response from nominal MC.Then, we can write:

$$< X_{reco}^{folded} >= s < X_{reco} > \text{ and } RMS(X_{reco}^{folded}) = rRMS(X_{reco})$$

- This means that, in the new distribution, the mean and RMS can be understood as the original ones but scaled by a factor s and r, respectively.
- Huge amount of MC templates can be built by mapping s and r over given range. The comparison of all those templates with data yields a χ^2 distribution which depends on s and r. Its minimization provides the template that best fits data (and consequently its s and r values associated).

FF method

- A high-purity signal sample of Large-R jets with high-p_T is obtained by selecting $t\bar{t}$ events in the lepton + jet final state (only μ channel is used)
- Two event selections are applied in order to obtain jets mainly formed from W or Top decays
- The relative JMS/JMR is derived by studying the jet mass spectrum of the Large-R jets that can contein either the full W or Top decay products, resulting in two different mass peak distributions
- $m^{folded} = sm^{reco} + (m^{reco} - m^{truth}R_m(m^{truth}, p_t^{truth})(r - s)$



Selection of Detector level event

- One muon with $p_T > 25GeV$.
- Jets with $p_T > 25GeV$.
- At least one small-R jet with $\Delta R(j, \mu) < 1.5$.
- At least one b-tagged small-R jet.
- Large-R jets with $\Delta R(j_i, j_k) > 2$.
- For boosted top sample: $\Delta R(b, j) < 1$.
- For boosted W sample, : $\Delta R(b, j) > 1$.

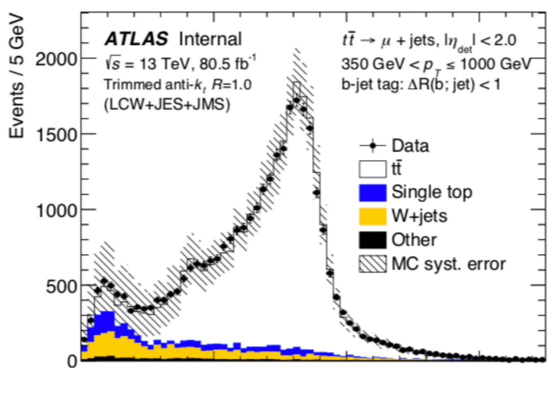


Figure: Top mass distribution for Calorimeter mass jet.

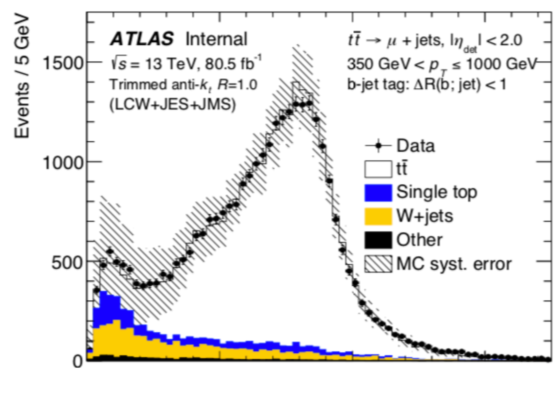
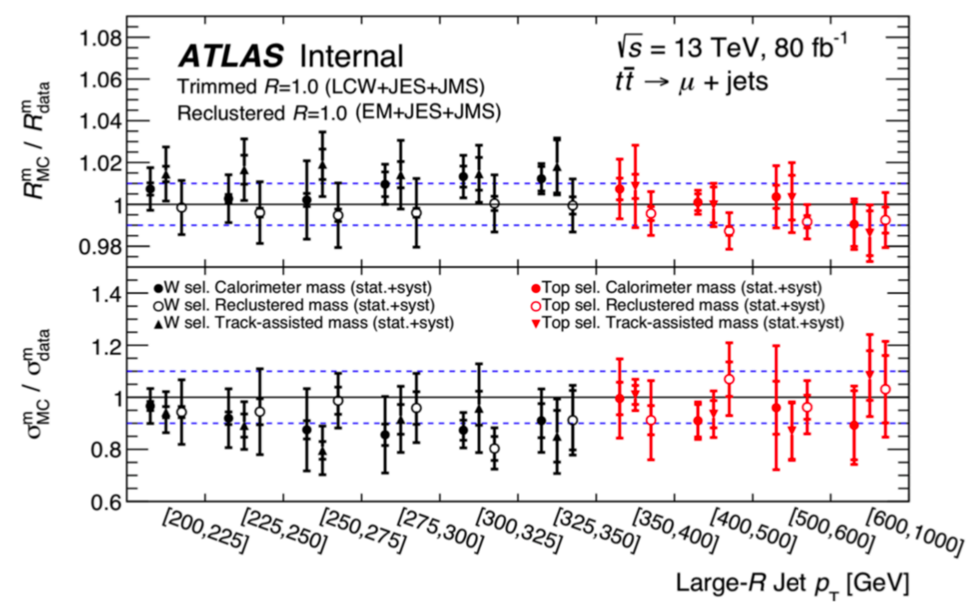


Figure: Top mass distribution for TA mass jet.



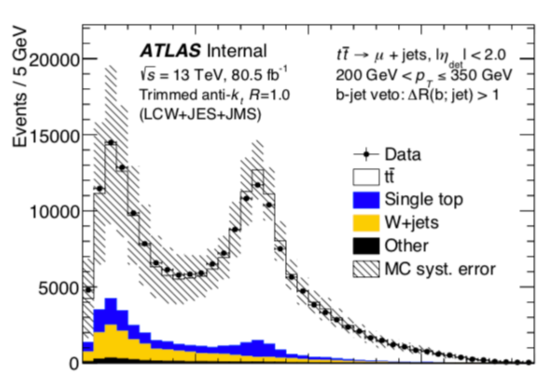


Figure: W mass distribution for Calorimeter mass jet.

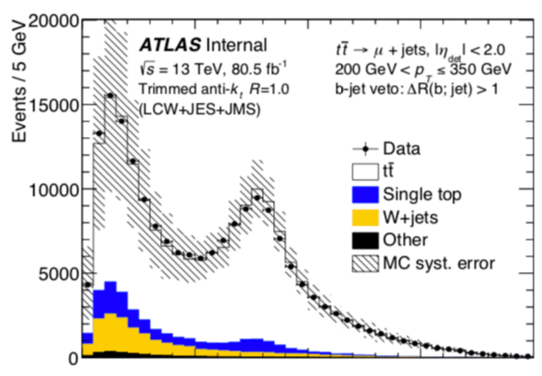


Figure: W mass distribution for TA mass jet.

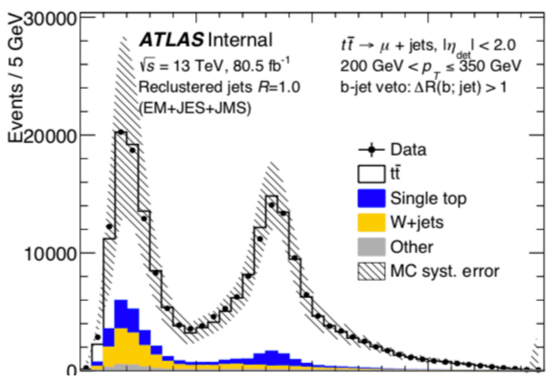


Figure: W mass distribution for Reclustered mass jet.

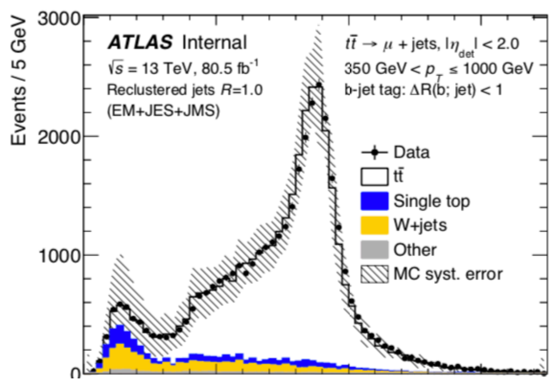


Figure: Top mass distribution for Reclustered mass jet.

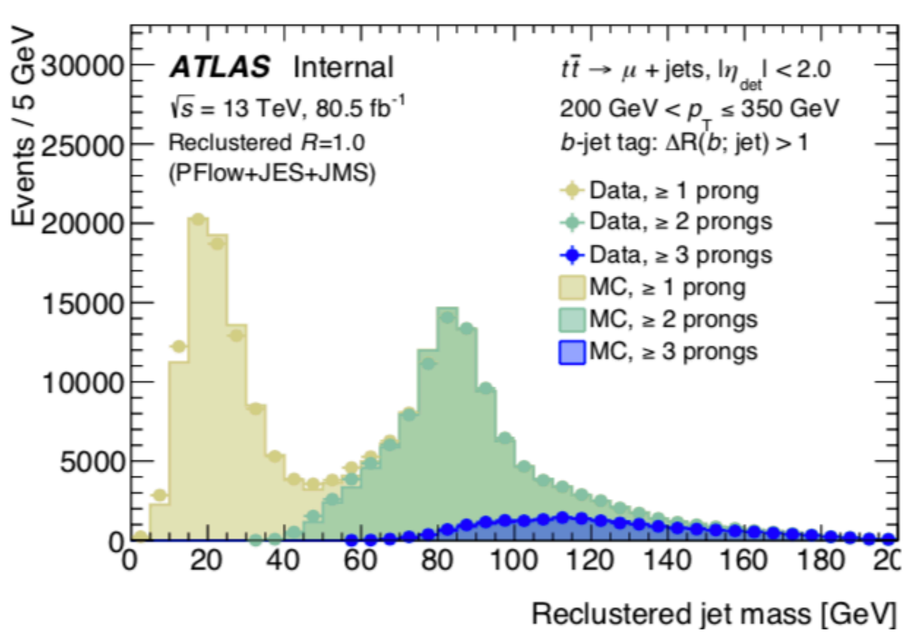
Summary

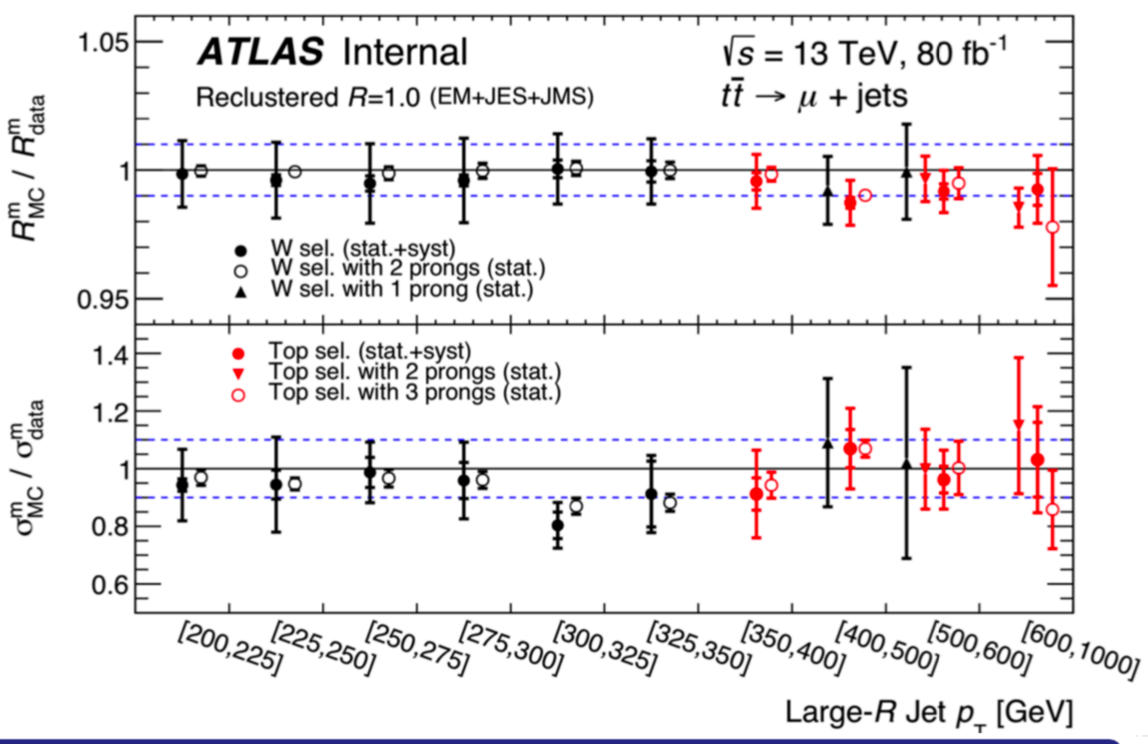
- For control plots, data and MC samples are compatibles within the statistical (and systematical) errors.
- Results for JMS/JMR of calorimeter, track-assisted and reclustered jets are compatibles with 1.
- Results for JMS/JMR of reclusteres jets for W selection better than for calorimeter and track-assisted jets (for JMS results differ less than 0.5 % and for JMR less tha 10 %, less for fifth bin.

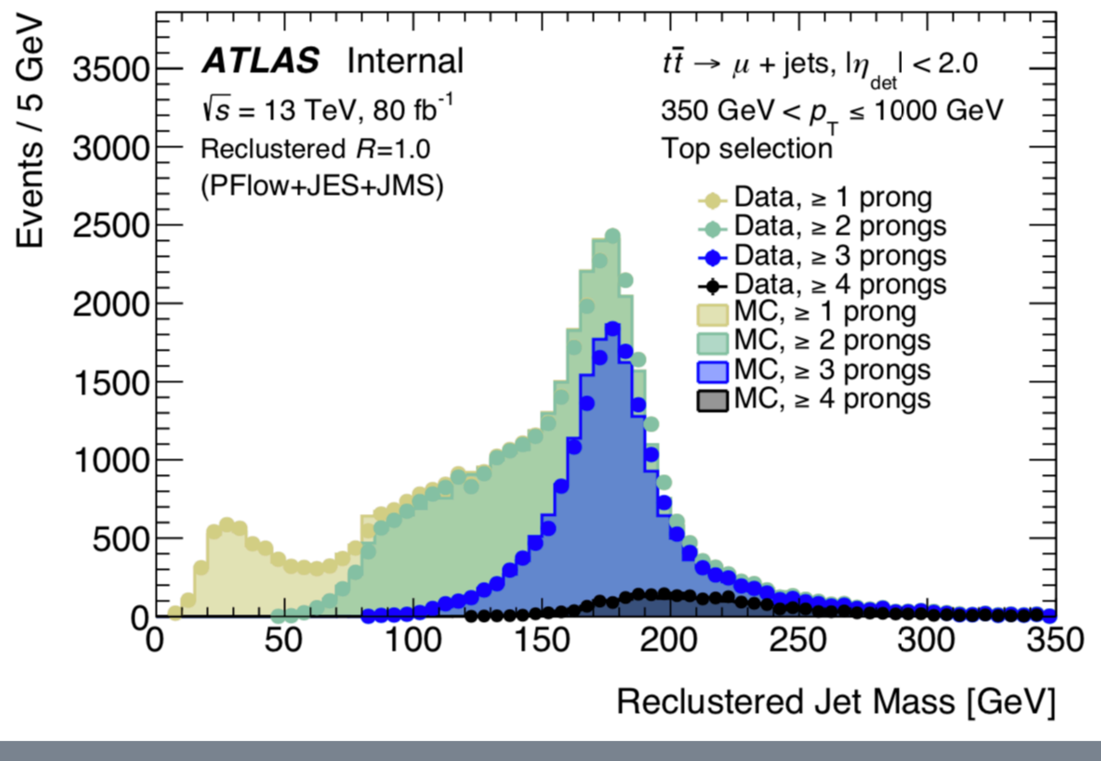
JMS/JMR new derivations

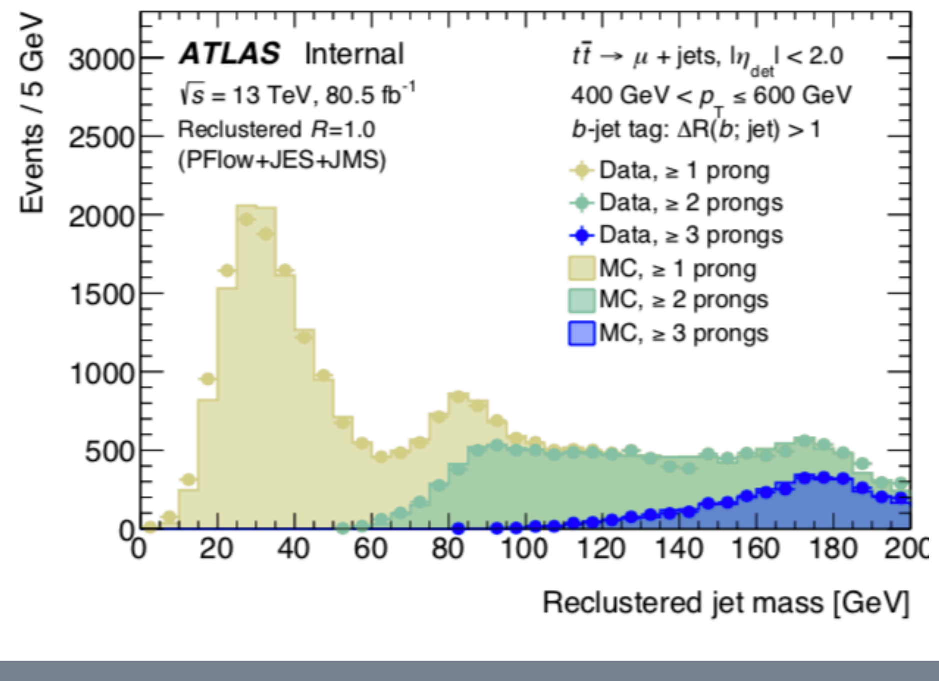
Study of Reclustered jets substructure:

- One small-R jets (one prong) for W distributions. Binning: [400-500], [500,600] GeV.
- Two small-R jets (two prongs) for W distributions. Binning: [200-225], [225,250], [250-275], [275,300], [300-325], [325,350] GeV.
- Two small-R jets (two prongs) for Top. Binning: [500-600], [600,2000] GeV. distributions.
- Three small-R jets (three prongs) for Top distributions. Binning: [350-500], [400,500], [500-600], [600,2000] GeV.









Summary

- Study of Reclustered jets substructure allows to obtain a purer sample where we eliminate the Chudakov peak and other jets that are not part of the W or the top.
- New results are compatibles with the inclusive results and statitiscal error more smalls (χ^2 fits shows narrower parabolas), except for the last bins of Top and W selection because there are less statistics.
- For the last bin of the JMS for Top selection using 2 or 3 prongs the result is worse than inclusive case. Is is due to the small statistics. For JMR the results between inclusive case and 2 or 3 prongs case are so different for the same reason.