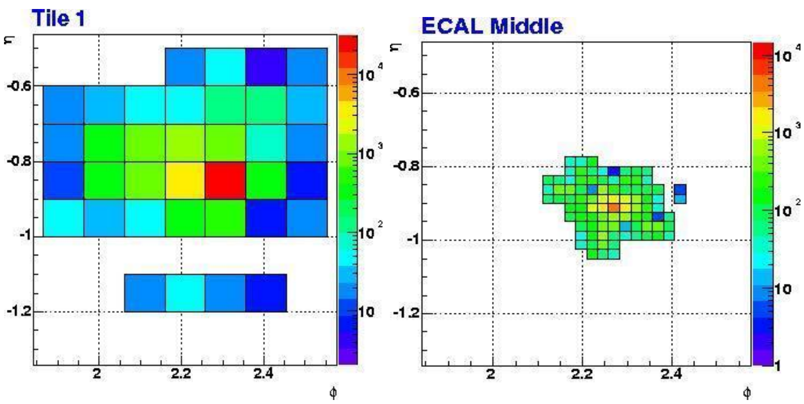
[1] Topoclustering and particle flow objects

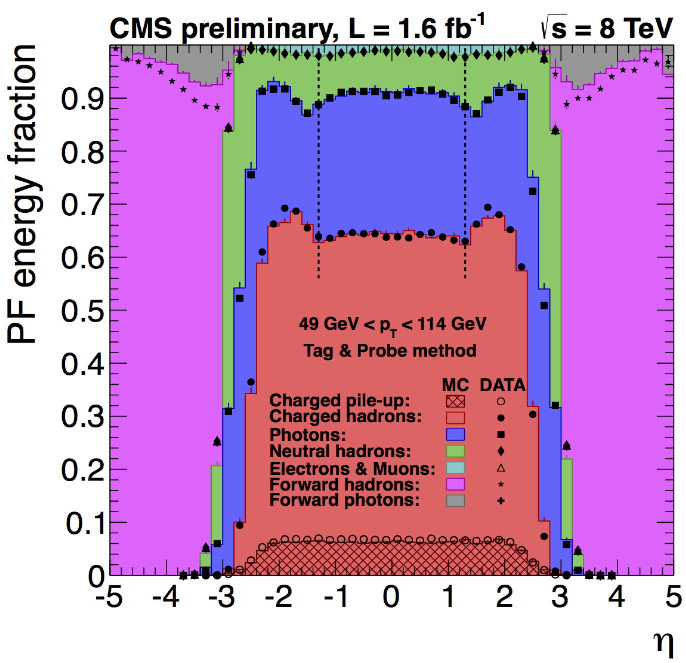
(Q-CMS) When does ATLAS clustering break down (angular resolution of the calorimeter)?

(A-ATLAS) Figures below show different slices from a shower in the ATLAS calorimeter. You can see the very fine granularity in the ECAL, but the limitation is in the TileCal, where the cells are 0.1*0.1.



(Q-CMS) Will we hit a limit due to detector granularity, where e.g. a W->qq decay is so collimated that we can no longer discern the substructure?

(A-ATLAS) Yes- for pT->10*mass we will start to see this.



(Q-ATLAS) I wonder what is the smallest possible jet radius that can be reliably reconstructed in CMS. Currently ATLAS uses R=0.2 as the minimum jet radius. Can you go smaller than this? We will enter the regime where the decay quarks from boosted W/Z/H can go below 0.2 (at pT(W) ~ 1 TeV for W'->WZ limit of ~2 TeV).
In this regime, the use of track information may become more important. Are you investigating the tagging performance with tracks or track-jets? This is not necessarily for flavor tagging, but also for jet substructure. This is actually a question to both of us...

(A-CMS) For pT(W)<500 GeV, the minimal jet radius is mainly limited by the ECAL cell size 0.016x0.016,

since the majority of the jet energy is reconstructed from tracks and ECAL.
For pT(W)>500 GeV, also the HCAL cell size of 0.087x0.087 is important, but we hope to compensate by improving tracking and particle flow algorithm in this regime.

(Q- ATLAS) You require your jets to be within eta<2.4 to be in the tracker (coverage to eta<2.5 by page 19 of TDR). But a R=0.8 jet on this border extends out to eta=3.2. How does particle plow work out here? Are Ecal/Hcal depositions assumed to be from pi(0)? How are substructure variables influenced by this transition region?
(A -CMS) The best plot for demonstration is on the right,
Between 2.4-3.0, charged hadrons (HCAL+tracker) transition to neutral hadrons (HCAL) while photons (ECAL) stay the same.
We don't have any public substructure plots specifically in this region, because in the searches the signal is usually at lower etas.
Jet substructure resolution is certainly degraded, wr.t. the central part of the detector.

(Q-ATLAS) Do you have any plots/numbers or something that can demonstrate how useful the particle flow technique is in terms of boosted massive object tagging?

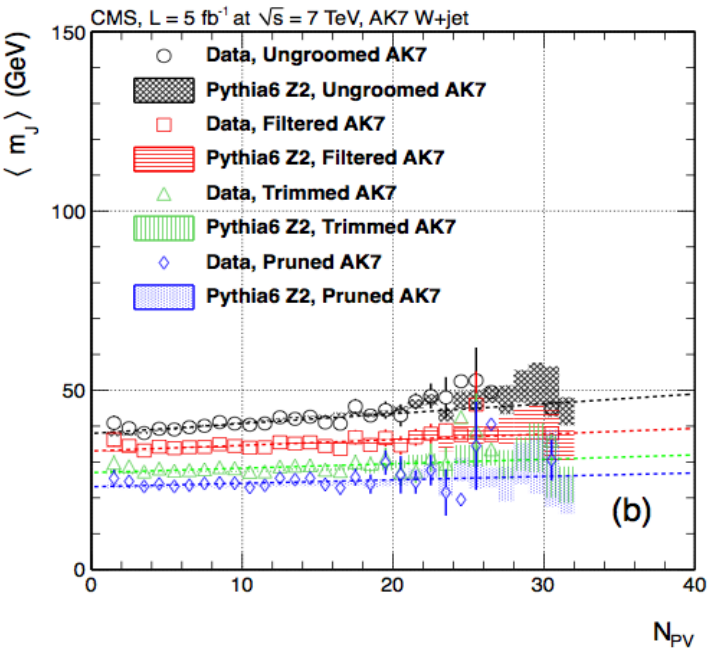
(A-CMS) The most useful plots are the comparison of substructure variables at generator particle level and detector particle flow level as show here:
https://twiki.cern.ch/twiki/bin/view/CMSPublic/PhysicsResultsJME13006#Pileup_and_detector_effects
In particular the last plot demonstrates how the detector particle flow compares to a toy particle flow with pileup at generator level.

[2] Jet reconstruction, grooming algorithms, subjets.

(Q-ATLAS) The pruning is chosen as a baseline grooming technique in CMS, and it's stated that the pruned jets mass has the best signal to background separation in JME-13-006. I understand that this is motivated by the study documented in arXiv:1303.4811. Is this correct? However, this paper doesn't seem to directly address the separation of W-jet signal from QCD background. I wonder if you have more direct comparison between different grooming techniques in terms of the optimization for the jet mass selection.

(A-CMS) We don't have a public comparison of various groomers for W-jet against QCD discrimination.
Optimisations for the next run are ongoing, but nothing public.

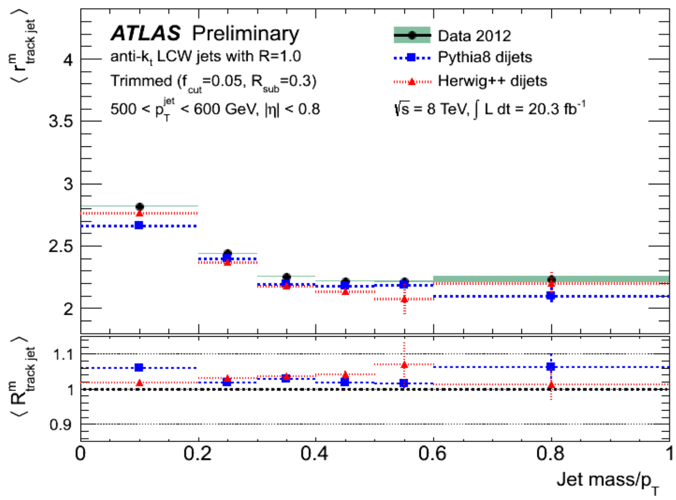
[3] Corrections to jets (calibration, pileup correction, pileup removal)



(Q- ATLAS) Why do you use pruned jets? In arXiv:1303:4811v2 you show (right) that it has a slightly reduced dependence on pileup. Were there any additional studies done to show it to be optimal?

(A- CMS) We did not choose pruning to solve the pileup problem, which was very small in 2012 with our charged-hadrons-from-pileup-subtraction.
It showed the rather strong QCD rejection needed for the fully hadronic searches. Certainly other groomers can be tuned to such tight QCD rejection as well.
We certainly also study grooming for pileup rejection for the next run.

(Q-ATLAS) Why do you include NPV in the MVA? Is it not dangerous to pickup up on some funky correlation between NPV and the substructure variables? Why not just use variables that are not dependent on NPV?
(A-CMS) We were interested in the best possible performance. Assuming our MVA deals well with the correlations this was the way to go. We don't suggest to use this MVA in an analysis, since we found one variable can practically give similar performance



(Q-CMS) What is the correlation between jet energy scale and jet mass scale in ATLAS? Is the jet mass uncertainty assuming that there is no knowledge about this correlation and jet energy calibration uncertainties are not propagated to the jet mass?
(A-ATLAS) This correlation is not directly taken into account in the derivation of the mass scale uncertainty. As discussed in arXiv:1306.4945, the jet mass response varies significantly (by about 20%) after the jet energy scale correction because the jet mass is affected by soft, wide-angle emission, which does not primarily impact the jet energy itself. In some cases where we consider the correlation, we quote the ratio of jet pT to mass (or the inversed one) to cancel the correlation to some degree, and make the plot of jet mass (or pT) response as a function of this ratio. This certainly make the response more stable in some cases.

(Q-CMS) In **arXiv:1306.4945** What corrections (if any) are applied to subjet objects after the 'standard' JES corrections?
(A-ATLAS) The subjets are reconstructed from LCW clusters so the correction to hadronic scale is included at the cluster level. The subjet-level correction (after the JES correction to the parent jet) is considered in the HepTopTagger approach. The subjet energy correction has been derived based on the comparison between truth jets and matched reco. jets for C/A jets with smaller cone sizes, as documented in Sec. 3.5 of arXiv:1306.4945.

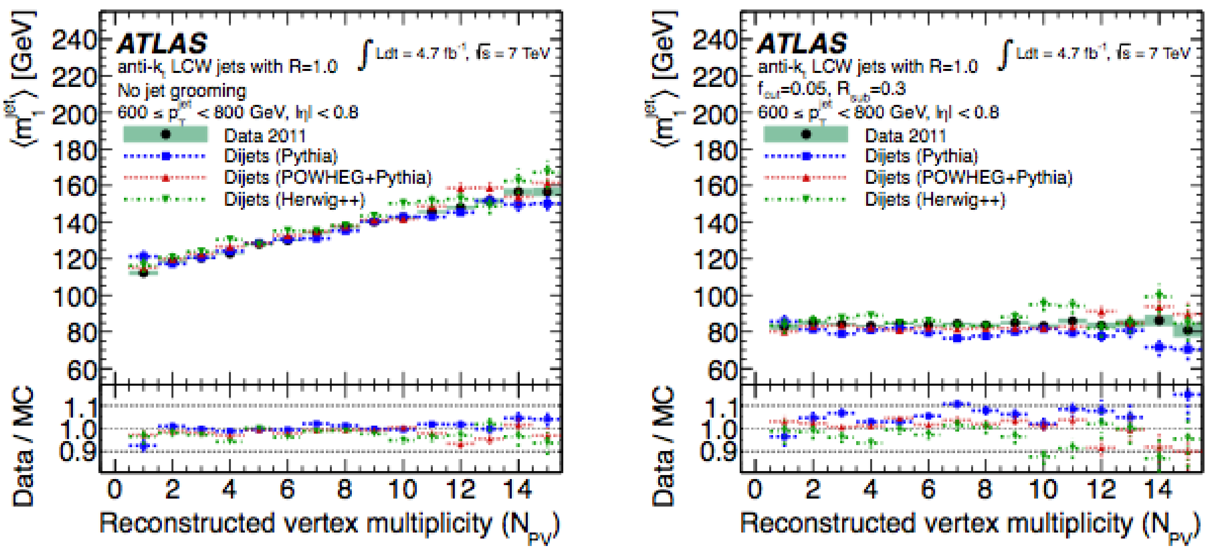
(Q-CMS) In **arXiv:1306.4945** Is your jet correction derived specifically for the large-R jets?
(A-ATLAS) The JES correction has been derived specifically for trimmed (5%, R_subjet=0.3) anti-kT R=1.0 and BDRS filtered C/A R=1.2 jets.

(Q-CMS) In **arXiv:1306.4945** What pileup corrections do you apply? Only grooming algorithms or something else + grooming?
(A-ATLAS) Nowadays the 4-vector area-based pile-up corrections are to be applied to groomed large-R jets at the subjet level during grooming and prior to the dedicated MC-calibration derived from gamma+jet and MC-based calo/track jet double ratios.This was not implemented in **arXiv:1306.4945**. At the time we had only MC-based double ratios available.The grooming does most of the job for pileup

suppression. It appears that the jet mass response is quite stable after grooming, bringing the mass response to the true boson mass (in case of boosted W) within the level of 1-2% (based on <M_calo/M_truth>).

(Q-CMS) In **arXiv:1306.4945** Looking at Figure 10 -How does this jet mass scale uncertainty evolve with high pileup?

(A-ATLAS) The jet mass scale uncertainty, estimated using the calo-track jet comparison, has been checked against pileup in 2011 data, and it shows that the MC can describe the data well, as stated at the end of Sec 4.1. As also seen in Fig. 19 (below), the average jet mass scale as a function of NPV is well described by POWHEG MC within ~3%. Of course, this will ned to be checked at much higher pileup, expected in Run II.



(Q-CMS) In **arXiv:1306.4945** The shift in the W mass peak seems to be larger for ATLAS (Fig 12) [FIG ABOVE] compared to CMS, at ~7 GeV vs 2-4 GeV. Is this due to the larger choice of jet size or some other detector effects?

(A_ATLAS) I don't know if either ATLAS or CMS can conclusively answer this. If we manage to make the same measurement with the same algorithm and see differences, then we can perhaps have an answer :)

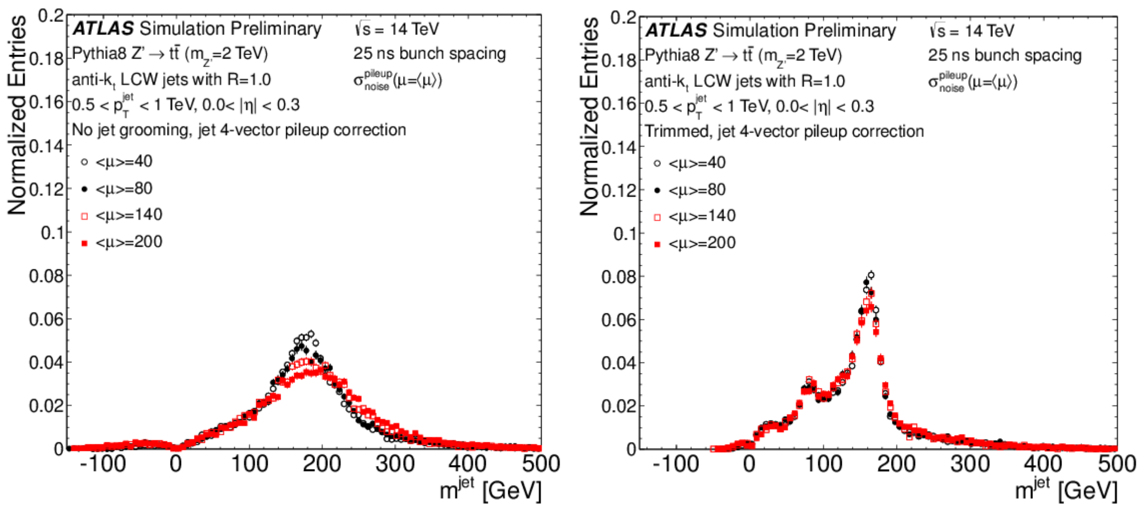
(Q-CMS) In **arXiv:1306.4945** Do you apply the uncertainty on subjets (section 3.4) separately for each one?

(A-ATLAS) In general, the uncertainty addressed by this calo-track double ratio method is considered to be dominated by detector effect so the uncertainty is considered to be correlated among the two subj

(Q-CMS) In **arXiv:1306.4945** You normalize the jet pT to the pT of tracks in the jet — what about neutral and pileup effects?

(A-ATLAS) The neutral components are assumed to behave similarly to the charged components, and physics effects associated with both charged and neutral ones are considered to be canceled in the calo-track ratio. As mentioned above, the pileup effect is well modeled by MC.

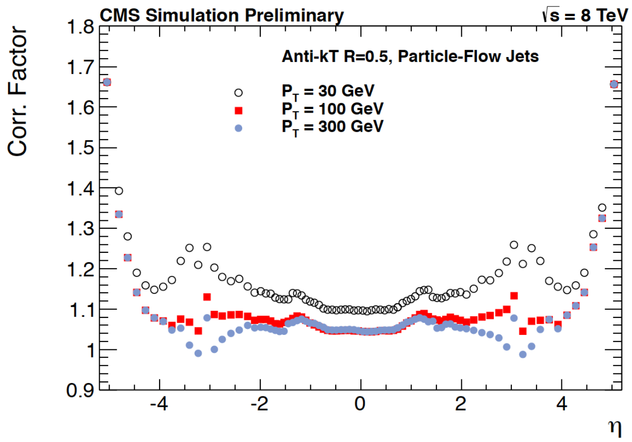
(Q-CMS) In **JetEtMissApproved2013HighMuSubstructure** General question — CMS sees the same jet corrections giving negative mass — is this 'okay' from the perspective of cutting on this quantity, and is it 'okay' from a theoretical perspective?
(A-ATLAS) This over-correction has been the subject of some discussion and study in ATLAS. There appears to be flavour dependence (light quark jets are more likely to go negative than gluon jets). One option is to not apply corrections in the cases where we get non-physical results.

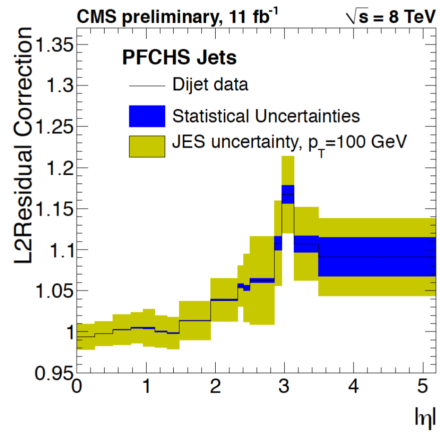


(Q-CMS) In **JetEtMissApproved2013HighMuSubstructure** Figure 3-4, the 4-vector correction appears to be less good for pileup of 140 and 200. Is this understood? It seems to work up to ~80.
(A-ATLAS) The jet 4-vector correction alone is not sufficient, but it does seem to help separating signal from background by combining with grooming [FIG ABOVE]. If you compare the jet mass distributions with trimming only and trimming + 4-vector corrections, the 4-vector correction sharpens the top mass peak for signal and brings the background jets to a lower mass even at very large pile-up of mu = 200.

(Q-ATLAS) The calibration for ungroomed C/A jets is described in PAS JME-13-006. I understand that:
- PU correction for charged particles (association with PV) is applied at PF level
- Neutral components are removed by event-by-event jet-area based correction
Do you apply any jet-level energy scale correction? It's said that it's small, but how small it is?

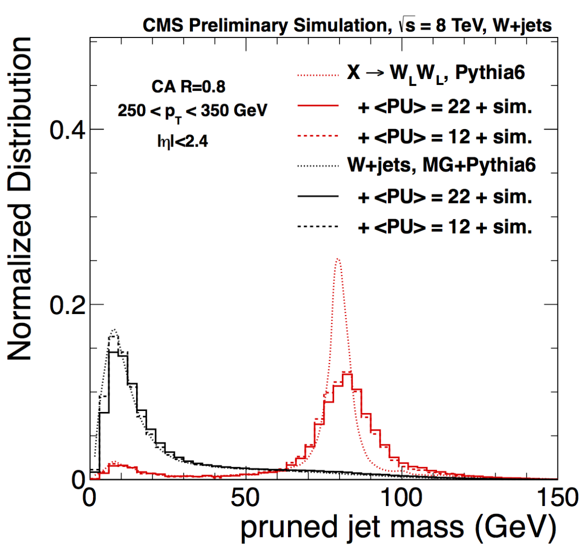
(A-CMS) The MC-based and residual(data-based) jet energy corrections are of order 5% for pT=100 GeV jets:

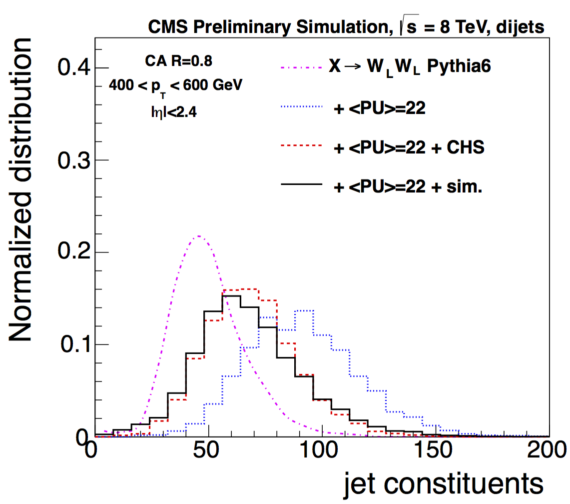




(Q-ATLAS)Do you have any JES correction for pruned C/A jets? Also, do you have any dedicated pileup correction on top of the pruning? These questions are related to a question for Fig. 1 (below). The pruned jet mass shown in this figure is corrected for JES/pileup (in addition to PF level calibration)?

(A-CMS) The statement may vary a bit depending on the analysis. However, what is clear is that whatever jet correction is applied or not, we estimate a scale factor from ttbar to apply it on top, so it doesn't really matter how the jet mass is calibrated.
We know from MC simulations that jet energy corrections (including pileup correction) for pruned jets and ungroomed jets agree with 2% independent of pT. The pileup correction is area-based and therefore automatically takes into account the smaller area of pruned jets and therefore results in a smaller pileup correction for these.

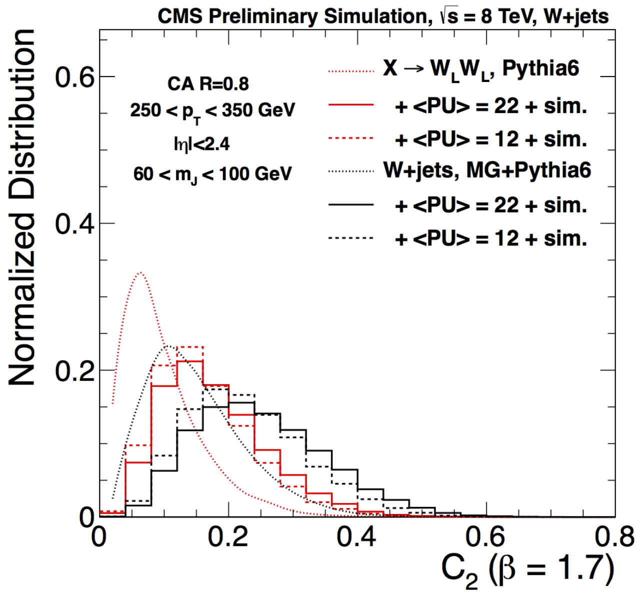




(Q-ATLAS) In the Fig. 7 left plot (above right), you show the number of jet constituents at the generator and simulation levels.If I understand correctly, the PU+CHS distribution at the generator level is corrected for charged particles from PU interactions. The PU+sim distribution (at the detector level with CMS simulation) is corrected for PU as described in p.3, right? Why do they agree as the neutral PU components are not corrected for the former, don't they?

(A-CMS) Neither the generator level +PU+CHS, nor the detector level +PU+CHS have a correction for neutral PU components applied, so they should agree and the jet constituents shown include neutral particle from PU. We only apply a correction for neutral pileup to jet energies, not to number of constituents or substructure variables.

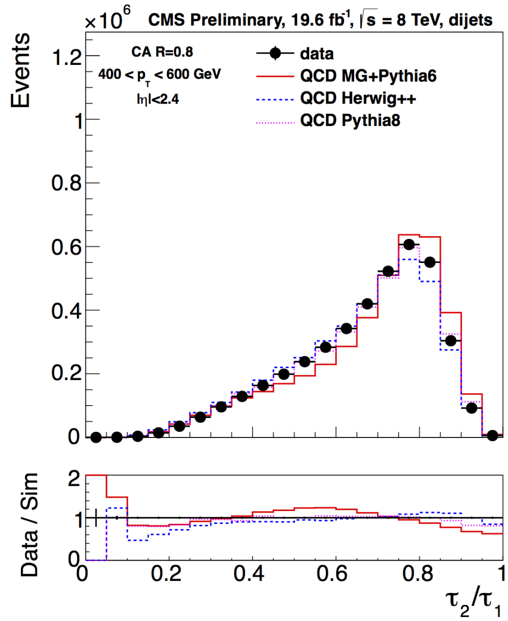
[4] Calo-based substructure variables : pronginess and radiation pattern variables. Including a discussion of systematics. MVA/correlations

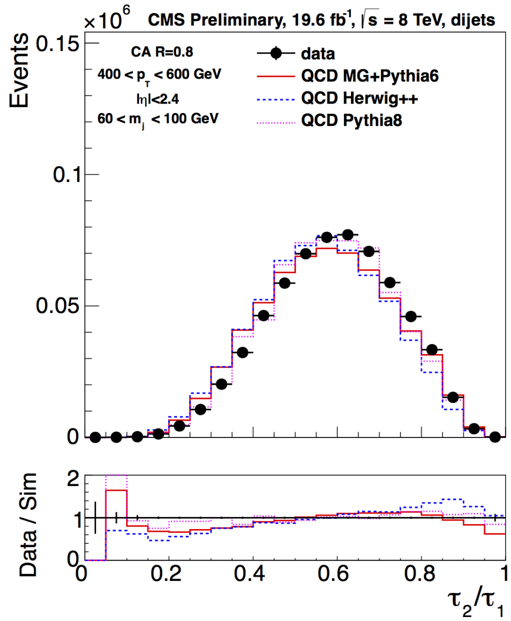


Q-ATLAS) Why is the E-E correlation function discrimination power changed so much when going from generator to reco? [FIG 5 LEFT]I think it is simulation and reco.

(A-CMS) We haven't followed up on the exact reason. It is a combination of pileup and detector efficiency (particle pT cut) and resolution.

(Q-ATLAS) Which tau21 do you use in the MVA?
(A-CMS) Our default (one pass optimization, no grooming)
We checked adding also the other flavors, but they did not add to the MVA performance.





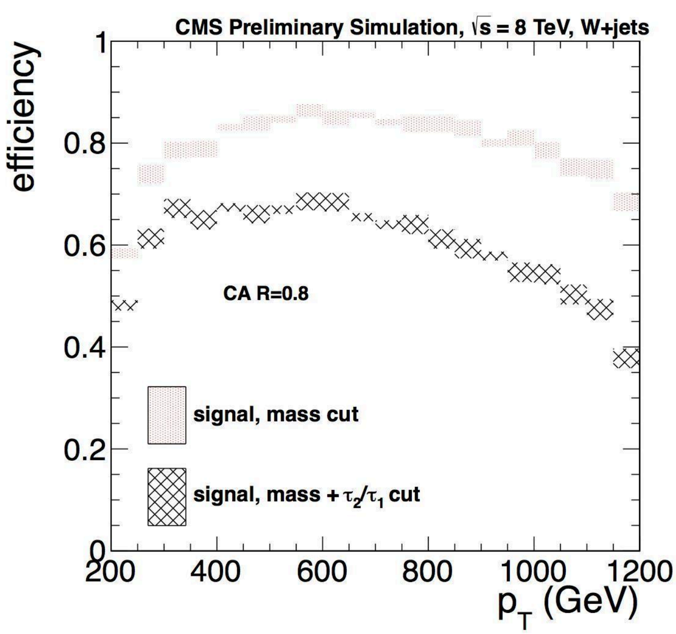
(Q-ATLAS) Is there any idea why the agreement of data and MC agree better after the mass cut (above)?

(A-CMS) A possible explanation is that if there is a problem in MC modeling jets with very soft radiation and small jet mass, it is removed by the jet mass cut to some extend.

(Q-ATLAS) Why do the signal efficiencies drop at high pt and NPV? Are the fake rates and signal efficiencies applied in analyses?

(A-CMS) In terms of the ROC curve there almost no dependence on pT and NPV. However, since particularly the tau21 discriminator is PU and pT dependent, a single working point tau21<0.5 is dropping in efficiency (and fake rate) with pT and NPV. These signal efficiency dependencies are taken into account in the analyses and backgrounds are anyways estimated in a data-driven way. To recover from the pT dependent efficiency drop in EXO-12-024 and EXO-12-022 and EXO-12-021, a category without tau21 requirement is introduced.

(Another solution is certainly to defined the discriminator in a pT independent way)

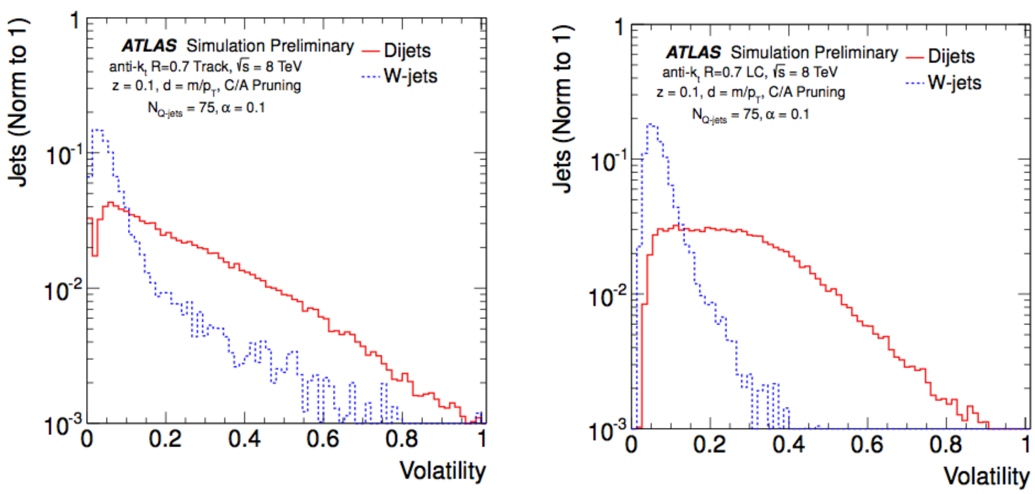


(Q-ATLAS) In section 7.3 0f **CMS-PAS JME-13-06**, you say that the shape you fit to the W peak is motivated by matching W bosons in the ttbar sample. What exactly is done here and what shape do you get out to perform the fit.

(A-CMS) We use truth-matched MC to find and validate the right fit function and constrain some of the parameters. We do this for both jet matched to true Ws and non-matched jets to obtain two fit-functions. These function are then used to perform the fit to data.

(Q-ATLAS) Are the uncertainties on the fit what you use as an estimate of the systematic uncertainty on mass? Aren't these an estimate of the statistical uncertainty of the sample? Aren't they limited to a small kinematic region?
(A-CMS) Right, the fit uncertainty is statistically limited and rather provides and additional cross check that the jet energy correction uncertainties cover. Jet mass and jet energy calibration are almost fully correlated, so this is kind of double counting.

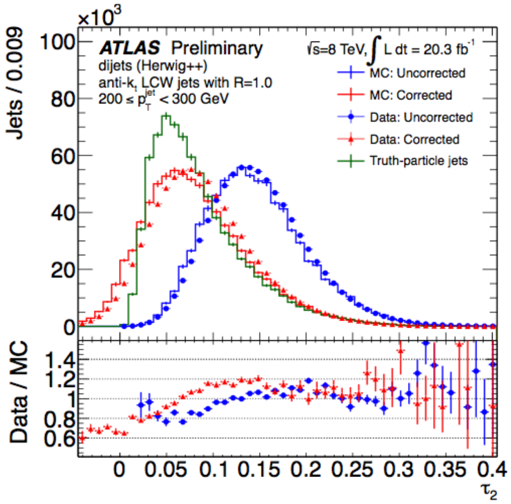
(Q-ATLAS) Are corrections made in data/MC using the information from these fits? If so, what does it mean to apply a correction to a data event which you don't know to be signal or background from a sample of signal W jets? [Note: This is the primary question I would like to know, how are systematics estimated when you don't have call only or tracker only jets]
(A-CMS) No corrections are made to the data.
The jet mass resolution is corrected in the simulation by an additional smearing of ~10%. In fact the disagreement between simulation and data in jet mass resolution is compatible with the disagreement in jet energy resolution of ~10% measured in dijet events, which is not corrected for this analysis (but jet pT measurements).



(Q-CMS) In **[ATLAS-CONF-2013-087]** I understand you use the topoclusters as inputs to the Qjet clustering algorithm. Would it make a difference if you use the individual tracks / track jets instead?
(A-ATLAS) This is checked as described in Sec. 5.7 (above). The separation power is reduced when using track-jets as the information from neutral particles is lost

(Q-ATLAS) For Qjets, you pre cluster down to 35 constituents. Is this done with pruning? How much speed does this gain in general? What the effect on Qjets and how it changes the resulting volatility studied?

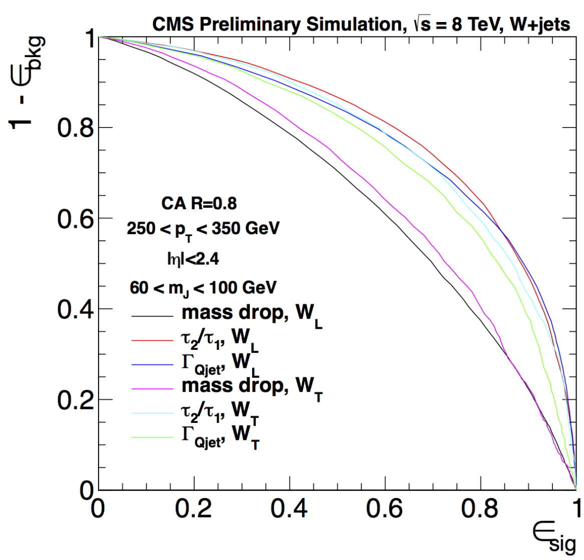
(A-CMS) The preclustering is done for the original (ungroomed) jet down to 35 constituents. The Qjets procedure is performed with pruning as is the default. The pre-clustering with 35 has no effect on the result. Anyways, now there is a much faster version of QJets available which solves this problem.



(Q-CMS) In **ATLAS-CONF-2013-085** Fig 5-6 - it appears that the data/MC is not in agreement after the correction for N_subjettiness values. Is this due to the specific generator? Have you looked at Pythia8 for this? It seems to work better for the top tagging observables.

(A-ATLAS) Pythia8 was also studied, and Herwig++ was actually found to be better in terms of Data/MC agreement. This was not studied at great length because the diagreement is largely washed out when the ratio Tau21 is taken.

(Q-ATLAS) Why is there such emphasis put on the influence of the WL and WT on the tagging [FIG 4 BELOW]? Is it mainly motivated by arXiv:1012.2077v2? Are you concerned that the tagger will now need to be a function of the fraction of WL and WT? And if so, then we need it to be a function of WL+,WT+,WL-,WT-,Z,H and this makes it model dependent. Is this built into the final choice you made for the tagger?



(A-CMS) An example motivation is arXiv:0911.3656. We don't know what you mean by WL+, WL-, WT+, WT-. Practically for W-jets, there is only WT (e.g. W+ or W-) and WL (W0). It turns out that W polarization gives the most "extreme" behavior for different behaviors, Z polarization is less extreme and is thus somewhere in between the W case. The Higgs is spin-0, so it is not relevant here. We didn't aim at making separate taggers. However, we think it is important to know the performance differences for WL and WT, especially when validating in a ttbar sample with a given WL/WT content, but using the tagger for pure WL or WT signals. In fact in the future we may include this as a systematic uncertainty as well.

(Q-ATLAS) Systematic uncertainty for tagging variables used in JME-13-006, e.g, scale and resolution of tau2/tau1 variable, doesn't seem to be directly estimated. Instead, any mismodeling of those variables is included in the uncertainty of tagging efficiency SF, estimated using ttbar events.
Is this the procedure you use?

(A-CMS) Mis-modeling is not included in the systematic uncertainties. Instead jet mass scale and resolution and tau2/tau1 efficiency are corrected using scale factors estimated from ttbar data and the uncertainty on these scale factors is accounted.

(Q-ATLAS) The accessible pT range in ttbar events is limited and you have two pT bins (200-265 and 265-600 GeV).
But, in the NP search with boosted bosons, you would have to reach higher pT around ~1 TeV or beyond to access resonance mass of >2 TeV. How can you evaluate the uncertainty at that high pT?

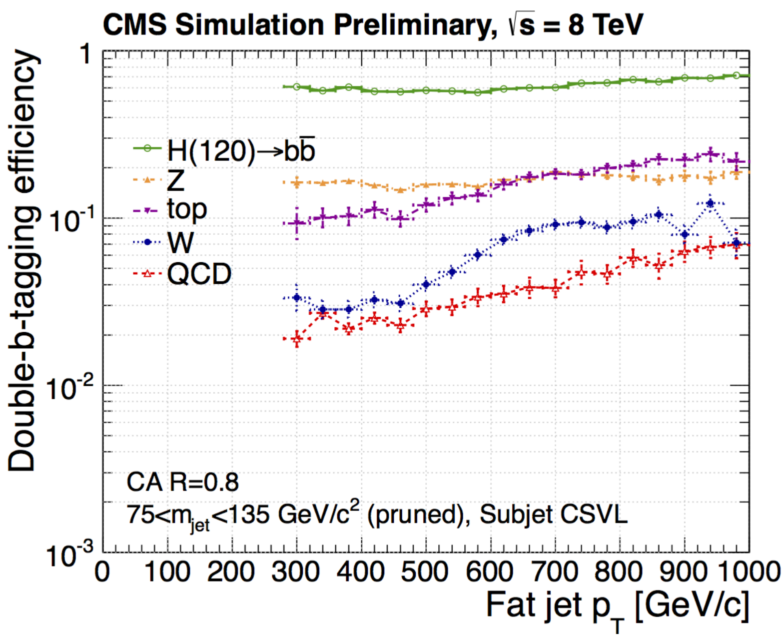
(A-CMS) An uncertainty to extrapolate the scale factors from ttbar to higher pTs is incorporated into the analyses EXO-12-024/EXO-12-022/EXO-12-021 based on the difference in modelling this extrapolation between Pythia6 and Herwig++.
The pT dependence of the fake rate was also studied in EXO-12-024 and showed that Pythia6 and Herwig++ model it very well as a support for the simulation-based extrapolation of the signal efficiency.

(Q-ATLAS) You have very nice ROC curves for the signal efficiency and background rejection. The tau2/tau1 (and Q-jet) appear to work very well for the pruned-C/A jets. I think we do see something similar. It's good to confirm between us. The mass drop doesn't look so performant in our case too.
Have you considered splitting scale or momentum balance between two subjets (obtained by de-clustering the last step of pruning procedure)? They appear to be have a good performance in our studies (though they are primarily considered for filtering and trimming).

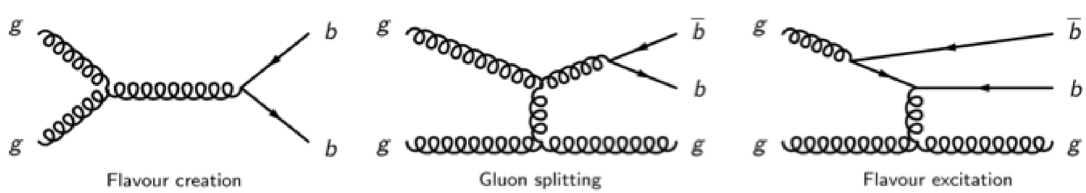
(A-CMS) We'll consider them as well in the furture.

[5] Track-based variables including b-tagging in the context of boosted objects (H->bb and g->bb) and also jet charge. Including a discussion of systematics. Issues at high-pT.

(Q-ATLAS) In **CMS-PAS JME-13-06** You advertise the techniques as being applicable to Z and H. Did you study how these techniques modify if you require a different mass window, more importantly for H?
(A-CMS) W and Z were studied in the context of EXO-12-024. For H jet substructure tagging we don't have anything public yet, but we are working on it.



One important thing to note is, that in H-tagging, b-tagging is a very powerful tool as we showed in BTV-13-001, more powerful than jet substructure discriminators [FIG 1 LEFT].
Of course, groomed jet masses are important as well for H, but one needs to take into account the jets are from b-quarks with somewhat different structure than light quarks. In the non-boosted case a b-jet energy regression was used in the SM H->bb HIG-13-012 search.



(Q-CMS) In **ATLAS-CONF-2012-100** Was the performance studied in boosted Z->bb or H->bb events?
(A-ATLAS) No. The 2011 analysis based only based on R=0.4 jets in the context of "resolved" topologies.

(Q-CMS) In **ATLAS-CONF-2012-100** The algorithm uses tracking variables to distinguish gluon splitting to bbar (GSP)
jets from single b jets. How does it perform w.r.t rejecting gluon jets only.
(A-ATLAS) This was studied in the internal backup documentation, where we show the distribution of the input variables for quark/gluon/b/gbb. Gluons are more similar to g>bb than single-b, but there is still a significant separation power. The g>bb vs mis-tagged gluon is worse than g>bb vs b, but you need to keep in mind that mis-tagged gluon jets are suppressed by a large factor because this technique requires

a b-tag.

(Q-CMS) In **ATLAS-CONF-2012-100** What is the distance parameter for the kT algorithm used to make the subjets?
(A-ATLAS) We used exclusive kT, with N=2.

(Q-CMS) In **ATLAS-CONF-2012-100** Was the MVA-based discriminator found to be insensitive to the secondary vertex info like, SV multiplicity, sum total of SV masses, etc.?
(A-ATLAS) Using vertex information decreases the efficiency of the method. Double b-tagging, for example, would set the maximum efficiency at around 30%. We did not use double b-tagging for this reason, but we are now adding a category (for the 2012) analysis that considers jets with 2 b-tags. We did try defining the variables only using large IP tracks, but this also had a significant hit in the efficiency (most of the time, the second B is not much displaced)

(Q-CMS) In **ATLAS-CONF-2012-100** What is the extent of correlation between the track jet width and the DR(kT subjets)?
(A-ATLAS) in a real g->bb jet, the splitting is ~symmetric, so when you recluster with kT, you get two ~symmetric jets, with centers on opposite sides of the jet. This gives some ~large value of DR. When you have a real b jet, then the reclustering with 2 exclusive kT jets gives you something a little bit funny: my recollection is that it's a slightly asymmetric system, with one jet more in the center and the other to the side. This has a lower DR. Width, as we know, just uses the radial information of the energy, but only in a linear way. The DR(kT) variable is a lot more complicated in some sense, because the distance it returns tells you about the breakdown in the symmetry of the jet, in some sense (basically, how compatible it is with a 2 subjet hypothesis). It's actually quite a lot like \tau_2 in that sense, but turned out to be better than \tau_2 when we were studying them.
There is correlation between these 2 variables, but you still gain by combining them as they are not 100% correlated.

(Q-CMS) In **ATLAS-CONF-2012-100** Since exclusive subjets were used was there any attempt to b-tag these two subjets using the standard b-tagging algorithms?
(A-ATLAS) See my answer above. This is something we are considering for the new 2012 tagger, but was not done in this CONF note.

(Q-CMS) In **ATLAS-CONF-2012-100** Fig. 7: While the DR(kT subjets) for single b-jets differ substantially between low and high pT jets, the difference is tiny for g->bbbar jets. Could you comment on the modelling of the GSP events and how uncertainties were treated. Did you validate the MVA variables in data using GSP-enriched events?
(A-ATLAS) All the validation was performed with inclusive b-tagged dijet events. The fraction of GSP was about 10-15%. Uncertainties were derived from tracking resolution, efficiency, b-tagging, and JES/JER variations. See also next answer.

(Q-CMS) In **ATLAS-CONF-2012-100** Do you have Fig. 12 with the data?
(A-ATLAS) Yes, but we were not allowed to publish it because it is "physics". This was very useful to understand the GSP modeling. Since everyone on this list is on ATLAS, the agreement was very good, even for the GSP-enriched region.

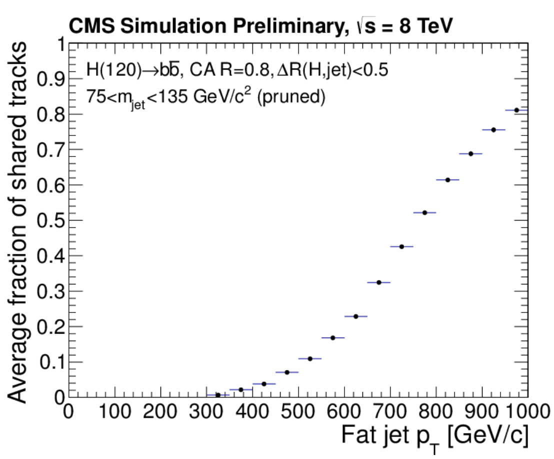
(Q-CMS) In **ATLAS-CONF-2012-100** Were jets with different cone sizes studied?
(A-ATLAS) No. Qi is now looking at R=0.6 and 1.0, but for the 2012 analysis.

(Q-ATLAS) In **CMS-PAS-BTV-13-001** Do I understand correctly that the double b-tag efficiency on the left plot of Fig. 22 is determined with respect to events that pass the pruned jet mass cut, while the Higgs tagging efficiency on the right is the combined efficiency for the requirements of the mass + double b-tag? If so,
- Why is the double b-tag efficiency for Z so high? Is it measured only for Z->bb events?
(A-CMS) The Z boson decays inclusively to hadronic modes. It has a substantial portion of Z->cc (~12%) and Z->bb (~15%) which would explain the larger efficiency. The efficiency of charm jets lie in the ballpark of 50-20% (pT and b-tagging operating point dependent.)

(Q-ATLAS) In **CMS-PAS-BTV-13-001** - The increase of double b-tag efficiency for the top, W and QCD with fat jet pT (on the left) presumably means the increase of mis-tagging rate. Is that correct?
(A-CMS) That's right. However the QCD multijets are the main backgrounds to the Higgs-tagging with ttbar and Z->qq at the percentage levels.

(Q-ATLAS) In **CMS-PAS-BTV-13-001** - If so, why is the efficiency for Z flat? I guess there will also be an increase of the mis-tagging for Z->qq, no?
(A-CMS) The Z boson has a higher percentage of decays into heavy flavours, and hence though there are true mistags, but also a big portion of “signal-like” events. This would explain why the efficiency is flat like that for the H->bb events.

(Q-ATLAS) In **CMS-PAS-BTV-13-001** The right plot of Fig. 22 shows that the mis-tag rates for the fat jets and subjets become similar at high pT. I understand that this is due to the increased share tracks among subjets. I suppose this happens because the tracks are associated to subjets within a fixed radius of 0.3. If you begin with independent track-jets (with a smaller radius, say e.g, 0.2) and then associate them to fat jets exclusively, I guess this problem is largely fixed. Is this not the case?



(A-CMS) The track sharing makes the subjet b-tagging highly correlated and hence the double subjet b-tagging efficiency approaches the fat jet tagging efficiency. While we have not investigated track jets associated to the subjets, the cone size etc. needs to be studied and optimized for the best performance using this method.

However we do think that using exclusive association of tracks to jets using a particle flow-based approach, instead of a fixed cone size, will remove shared tracks between subjets.

But the main problem here is not b-tagging of the correlated subjets themselves, but estimating the systematic uncertainties, which are based on the data/MC scale factors. The scale factors cannot be applied to individual subjets but the correlation has to be accounted for somehow. A compromise would be to use subjet b-tagging in the region where

DR(subjets) is large (> 0.4) and switch to fat jet b-tagging below this region.

[6] EXTRAS

(Q-ATLAS) In **CMS-PAS JME-13-06** you choose signal samples with pT "similar" to that of the background. What does this mean? (Note: we should describe in the presentation how we merge our signal samples)
(A-CMS) We use a narrow signal resonance with two times the center of the pT window. The background spectrum also shows a peak in the pT window, because it is steeply falling, but also has a turn-on due to the additional event selection.

(Q-ATLAS) How was the M(j)=[60,100] GeV window optimized?
(A-CMS) Separately for each analysis, depending on how much background rejection power is needed. 60-100 is from the semileptonic WW search, while the fully hadronic VV search uses a tighter window.

(Q-ATLAS) For the pileup dependence studies with 12 vs. 22 NPV, how were these samples made? Did you just split a sample by NPV, or did you generate two separate samples?
(A-CMS) This is just splitting our <npv>=22 sample in two.

(Q-ATLAS) Is the cos(theta_J) variable the same as cos(theta*)? Is it calculated in rest frame of the jet? What does it mean to boost jet constituents to a non-detector frame, in particular boosting pileup constituents to that frame? [Note: Same question applies to CoM variables]
(A-CMS) Sorry, but how are you defining cos(theta*)? Is this the polar angle w.r.t. to the production axis? If this is the case, then the angles are not the same. This is generally characterized as the angle of the subjets (or partons) in the W frame. A more precise definition can be found in Eq. 4 of arXiv:1208.4018.

(Q-ATLAS) You use the trimmed grooming sensitivity in the MVA. Do you use all three sensitivities that they use in arXiv:1012.2077v2? What does it look like in 1D? Why is it not shown here?
(A-CMS) We checked adding also the others, but they did not add to the MVA performance.
There is no particular reason why it is not shown. It wasn't under the top 8 variables we picked for the PAS. If it is of high interest, we can probably add it to the public material.

(Q-ATLAS)
* JpTS, JMS, …. how are these correlated?
* Bottom-up / top-down approach : looking at cluster-level or p-flow level

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(Q-ATLAS) In PAS JME-13-006 You use several MC samples to estimate the multijet and W+jets backgrounds, but presumably you use only one of them in the signal/background comparison of tagging variable distributions and the derivation of ROC curves. How much does the behavior of the ROC curves change by using different background MCs?

(A-CMS) Modelling of quarks in the Pythia6 and Herwig++ samples is very similar, the change in fake rate mainly comes from the gluons as demonstrated on pruned jet mass and tau2/tau1 in this plot:
https://twiki.cern.ch/twiki/pub/CMSPublic/PhysicsResultsJME13006/substructure_pas_pt_eff3.pdf

This of course also changes the fake rate in the ROCs. However, it didn't affect how the discrimination power of the various variables compared.