JETS:
what next?

conveners:
Ben Nachman & Simone Marzani
dedicated e-group
&
slack channel

Jets@LesHouches

- Jet studies at Les Houches has been very productive!

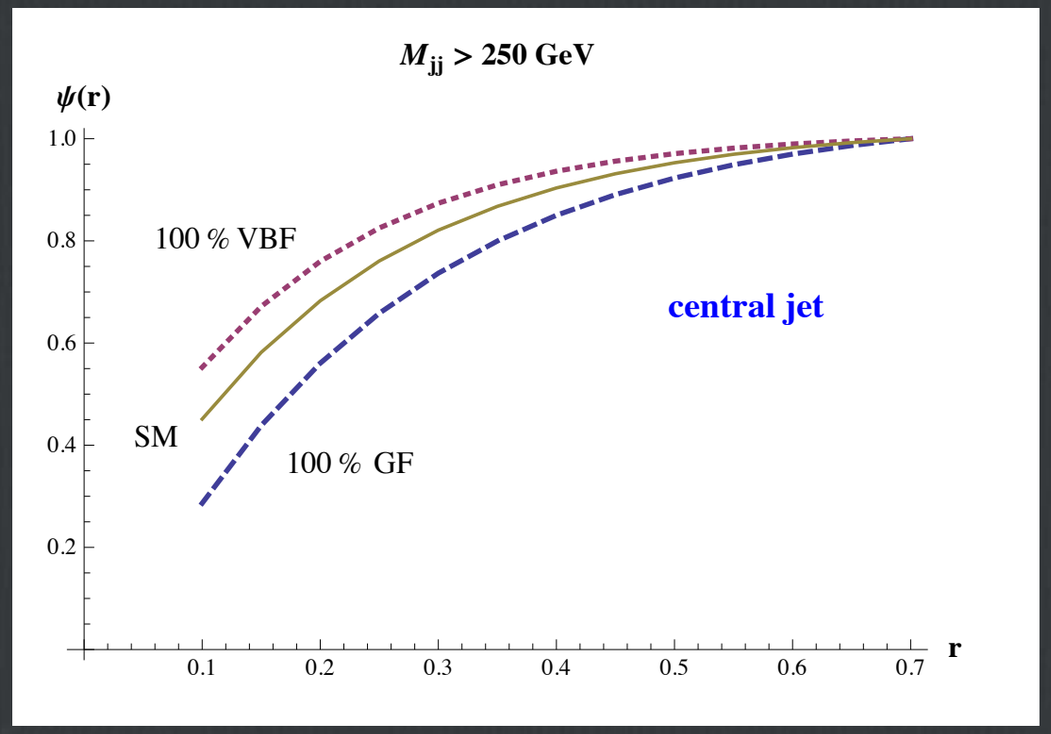
- LH15 featured a systematic studies of q/g discrimination exploiting MC studies of angularities
  - limitations in modelling gluon radiation were discovered
  - follow-up study featured analytic predictions as well

- LH17 concentrated on two aspects of jet substructure
  - measurements & precision: towards strong coupling extraction
  - more reliable tools: understanding performance and robustness

Where is q/g tagging actually useful?

- look at analyses where q/g is or could be employed
- main question: are other analysis cuts already purifying the sample?
- e.g. requiring two forward jets with large m_{JJ} already suppresses gluon jets for VBF/VBS

- other examples:
  - $X \to gg$
  - SUSY cascades
  - ISR tagging
  - boson tagging
  - top tagging

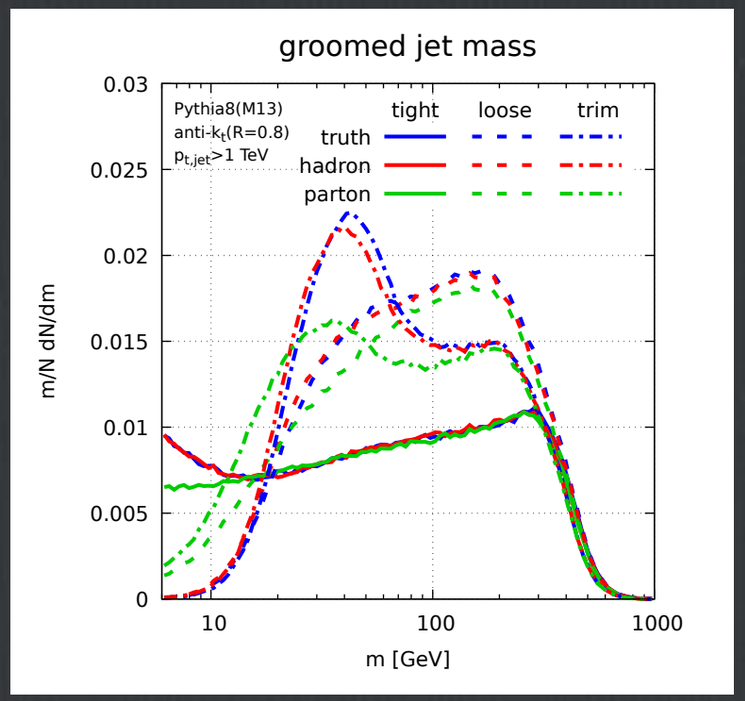


sub-topic: q/g and PDFs

- the inclusive jet cross-section is currently the only jet observable entering PDF fits
- can we gain q/g separation in the initial state by tagging the flavour of a final state jet, i.e. looking at the p_T distribution of a gluon jet?
- experimental issue: how much q/g performance do we need?
- theory issue: we need a flavour tagger that we can calculate with decent precision

Extracting SM parameters

- Groomed observables are resilient against non-perturbative corrections
- some groomers (e.g. soft-drop) are amenable to precision calculations (see Felix Ringer's review talk on Thursday afternoon)
- one of the topics studied at LH17 was the extraction of strong coupling constant from groomed jet shape started to be investigated
- can we investigate this in more detail and reach firmer conclusions?
- we can study different observables / groomers / event selections



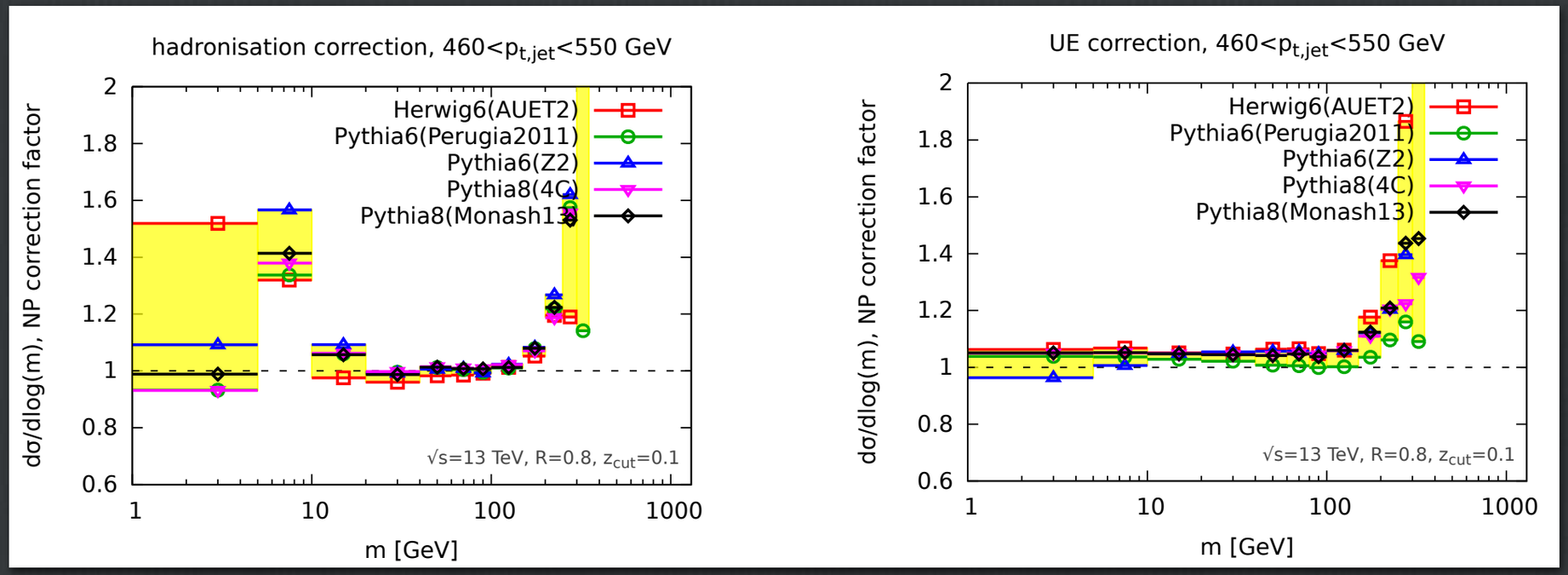
sub-topic: top mass & the inclusive measurements

- another place where grooming techniques are being investigated is top mass extraction
- there is a long-standing discussion about the size of non-perturbative corrections (see e.g. Hoang et al., Ferrario Ravasio et al.)
- does grooming reduce non-perturbative ambiguities?

Table 2: Uncertainties on m_t^{MC} after various corrections are included. Percentage change from no grooming, without W-calibration is shown in parenthesis. We estimate around a 50 MeV uncertainty on these numbers due to statistical fluctuations and fitting inaccuracies.

	without W calibration		**with W-calibration**	
No grooming	530 MeV		200 MeV	(−62%)
Trimming	530 MeV	(0.0%)	170 MeV	(−68%)
Soft drop	390 MeV	(−26%)	140 MeV	(−74%)
e^+e^-	110 MeV	(−79%)	50 MeV	(−90%)

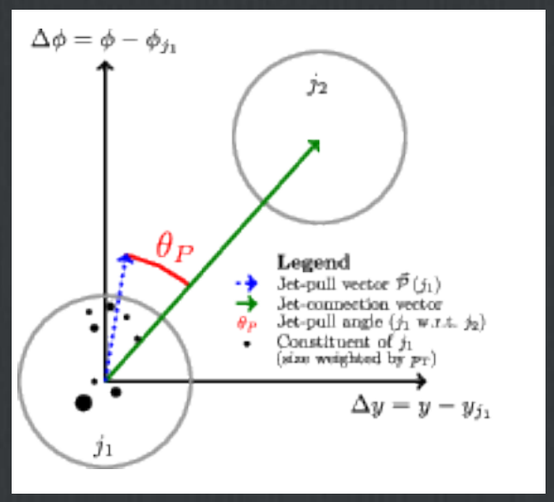
Tuning with jet substructure

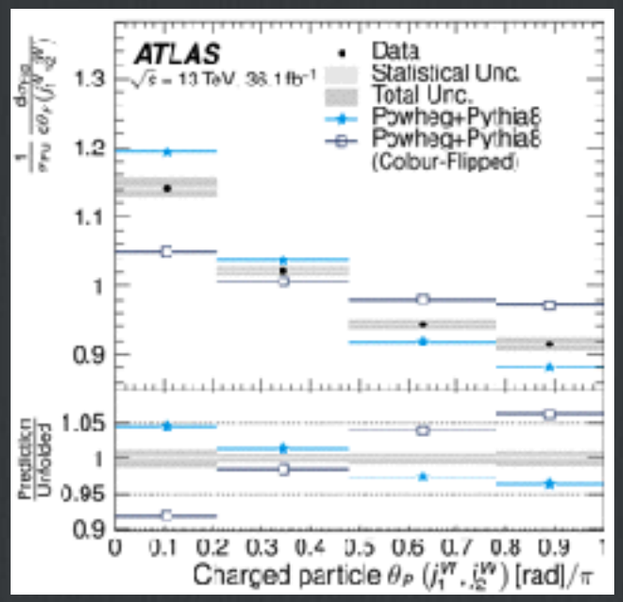


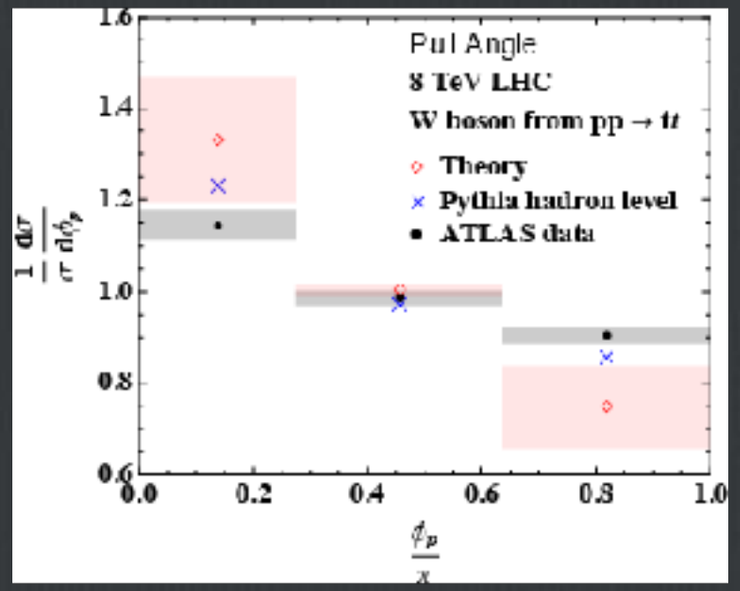
- which observables are actually sensitive to which parameters?
- what has been measured?
- what is the interplay with grooming? (we know from tagging that observables good without grooming do not necessarily perform well after grooming)
- IRC safe / unsafe observables?

sub-topic: jet pull

- Jet pull is a shape that is sensitive to colour flow
- can we understand the ATLAS jet pull angle measurement from the point of view of parameter variations? (quite significant tension between Pythia and data).



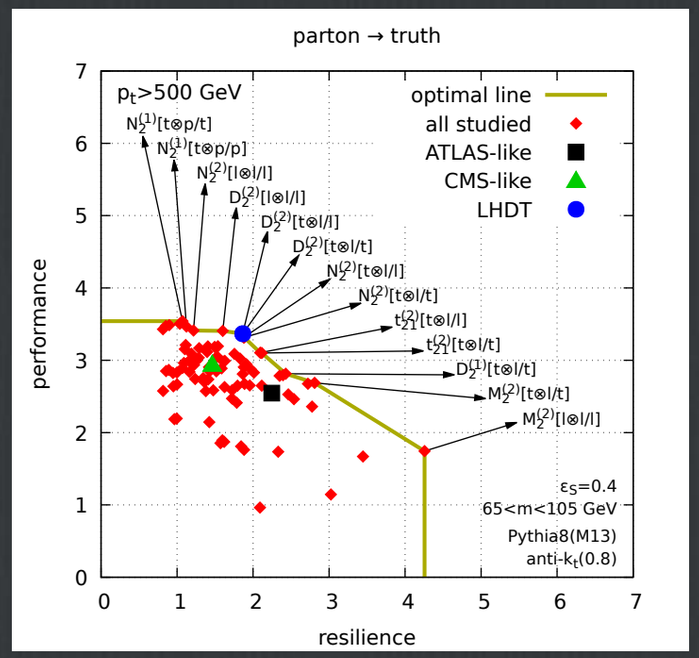




- the pull angle is not IRC safe, can safe projection of the pull vector help?

Machine Learning for jets

- In LH17 there was a big effort to understand light 2-prong tagging in terms of performance and resilience
- meanwhile the use of machine-learning techniques in jet substructure has become mainstream
- in a <u>recent review</u> a detailed comparisons of ML techniques in the context of top tagging was performed
- we could perform a similar study for two-prong taggers
- can we boost the sensitivity of Higgs taggers using ML?



Plan for this workshop

- if you have other ideas for projects, they are more than welcome!
- out of the list just presented, some topics are very “jetty”, other ones can naturally be of interests for MC or PDFs experts
- experience (=Jesse Thaler) teaches us that the best strategy for LH is to concentrate on a couple of projects
- this way can have enough people to actively work here in LH and make good progress
- details and refinement can be done after LH for the proceedings, but we think it is crucial that we leave LH already with a good story to tell

come to the brainstorming session!