GSC calibration applied to the ZH ($H \to b\bar{b}$) analysis

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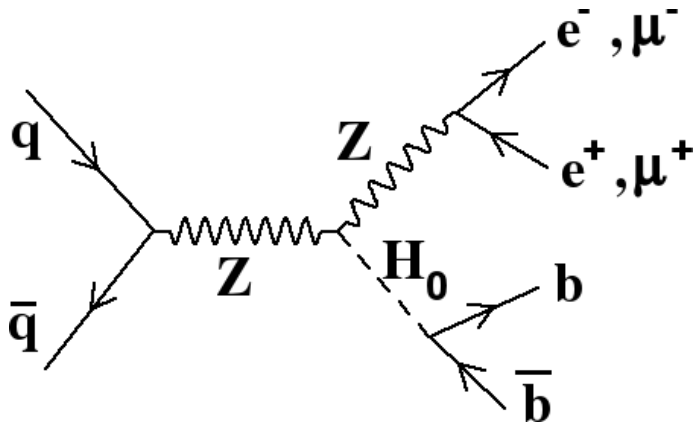
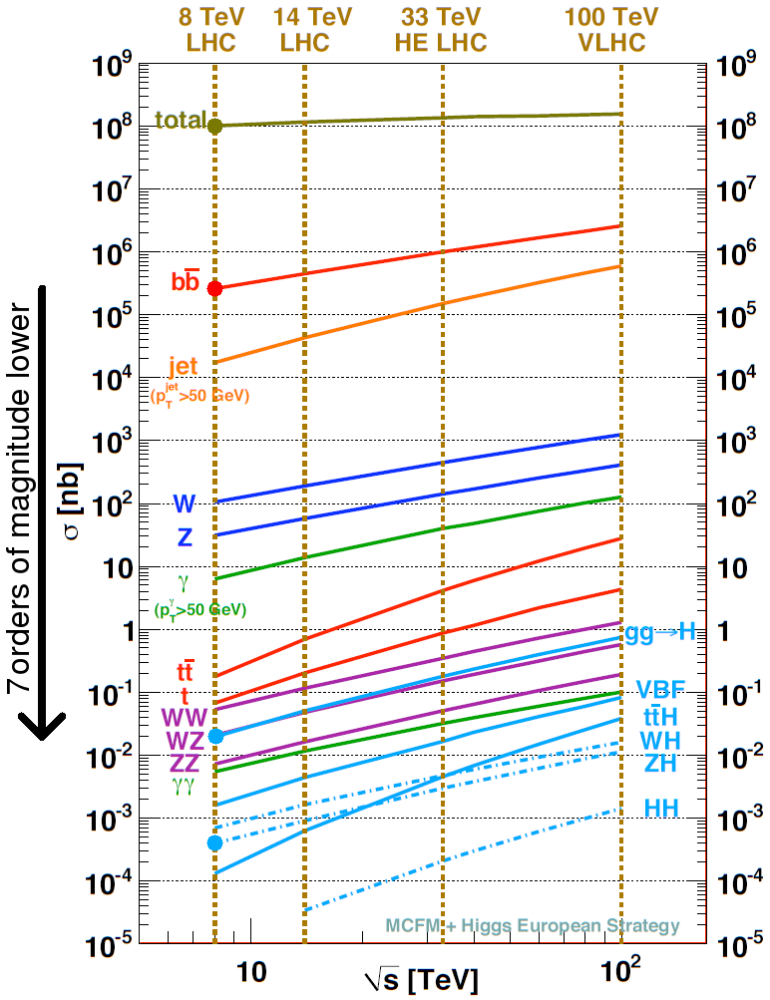
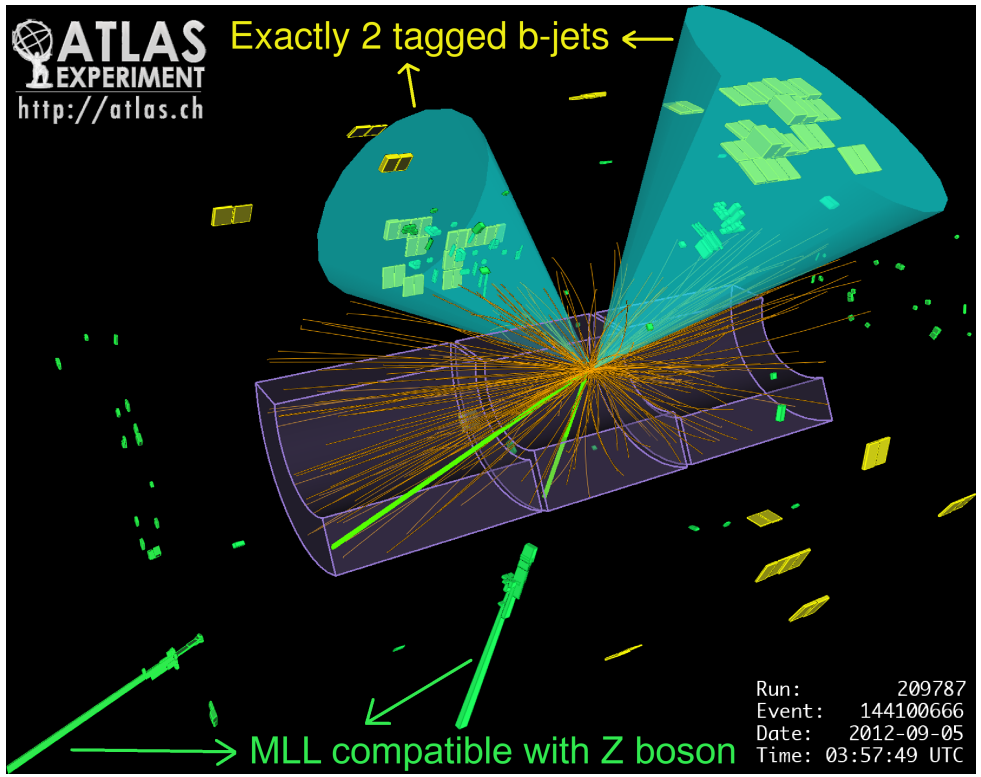


Acknowledgements:

$ZH \to \ell\ell b\bar{b}$

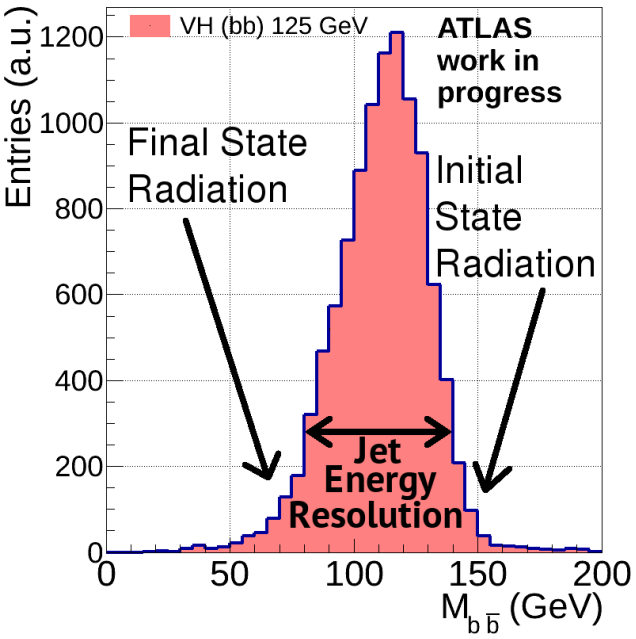
- $H \to b\bar{b}$ probes the Higgs coupling to quarks but is affected by very large backgrounds.
- Studied in associated production with a vector boson
  - leptonic decay used to trigger the event.





- Search for an excess of events on the invariant mass distribution.
  - Still large backgrounds (Z+jets, $t\bar{t}$ and ZZ).
  - Best invariant mass resolution is crucial.

Global Sequential Calibration



- Developed to improve the jet energy resolution.
- Tested improvement of VH $b\bar{b}$ mass resolution.
- Corrects the jet energy response (p_T^{reco}/p_T^{truth}) dependence on some jet properties.

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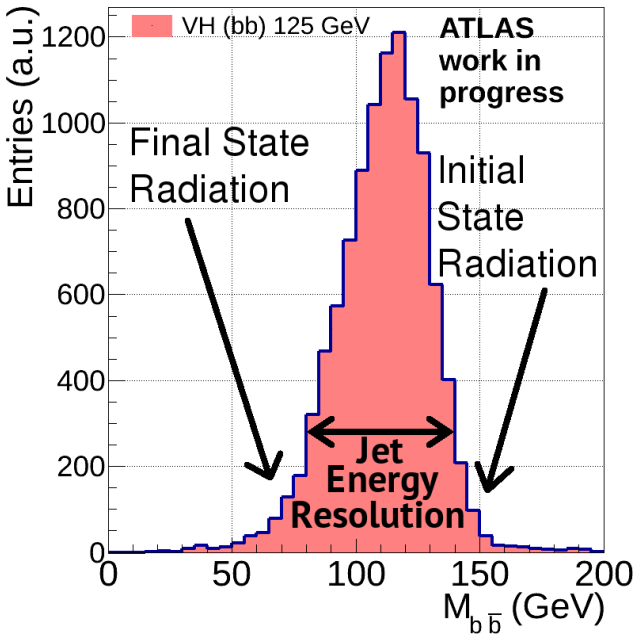

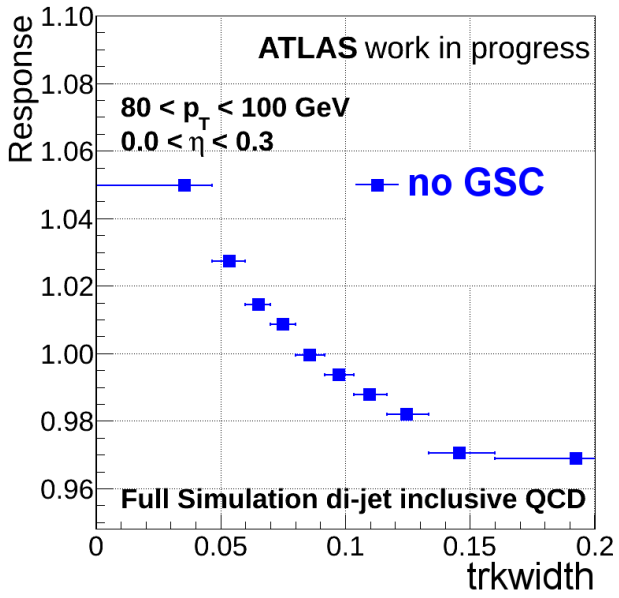

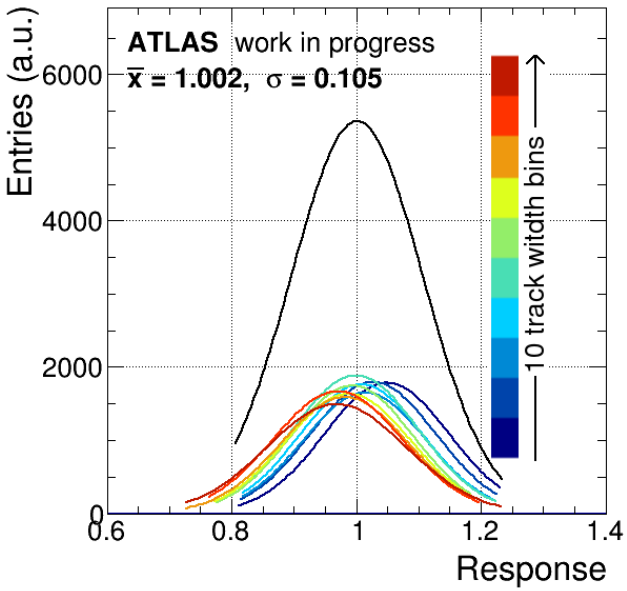

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- Before applying GSC the response distributions for each trkwidth bin are spread.

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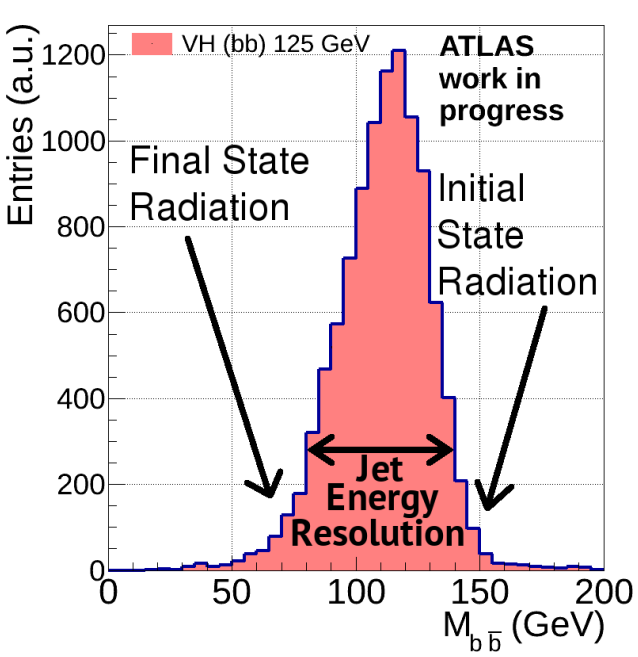

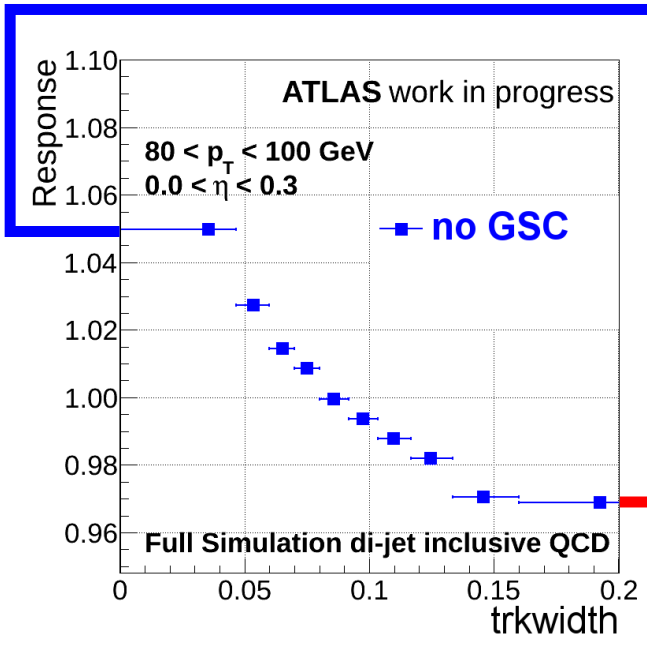

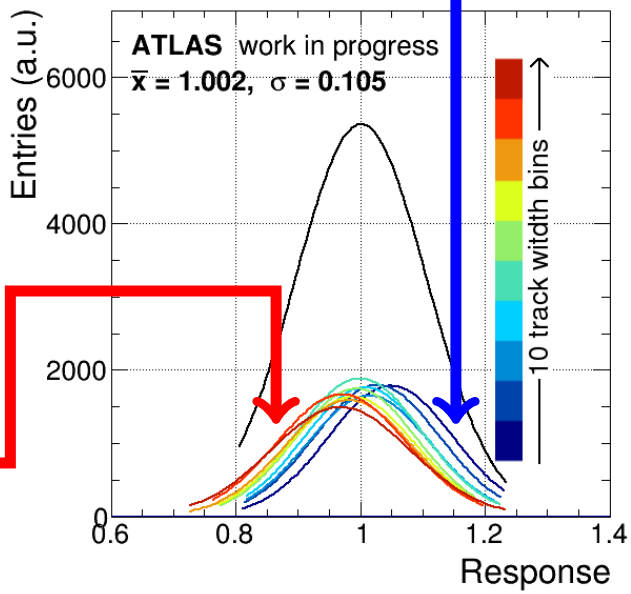

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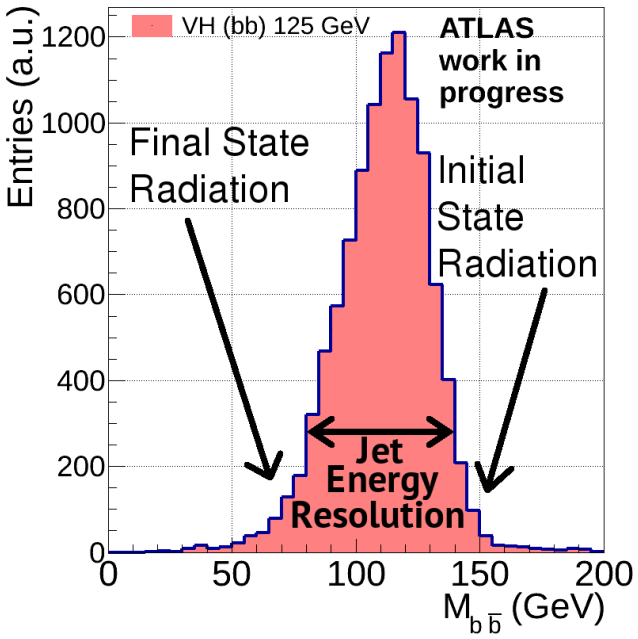

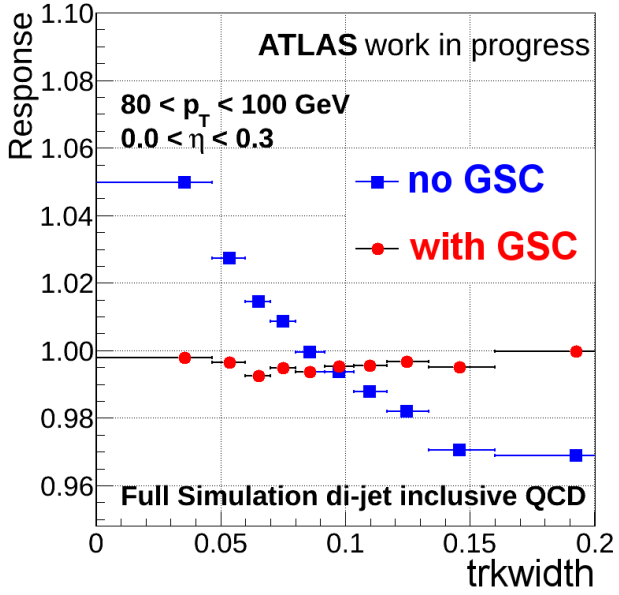

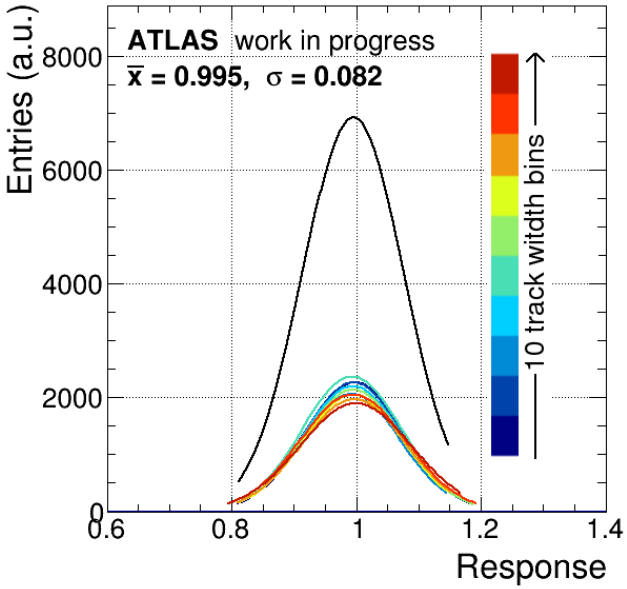

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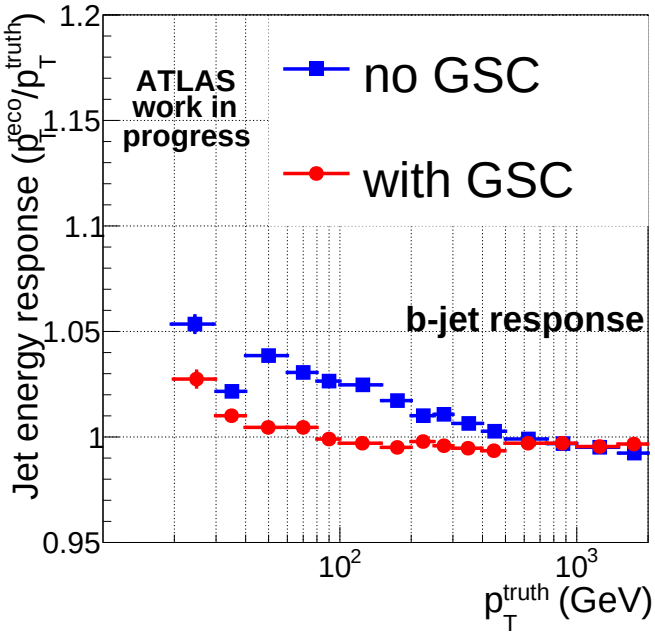
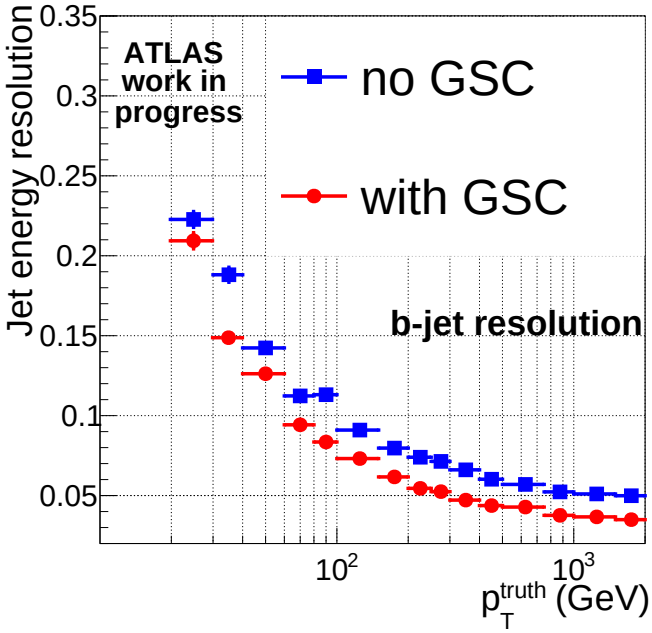
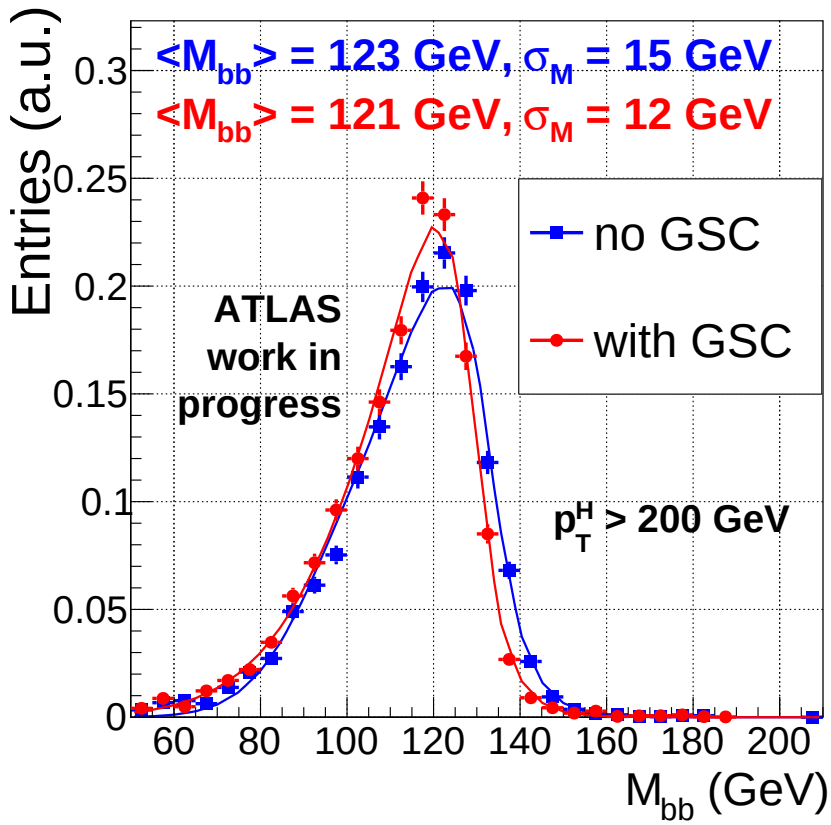
- Before applying GSC the response distributions for each trkwidth bin are spread.
- After GSC, the distributions are aligned, improving the resolution.

GSC b-jet performance



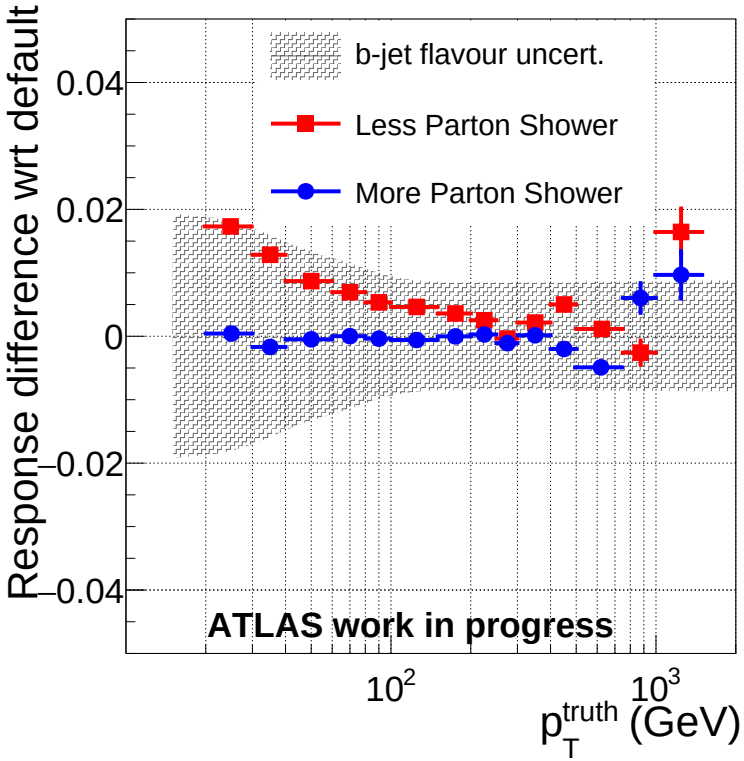


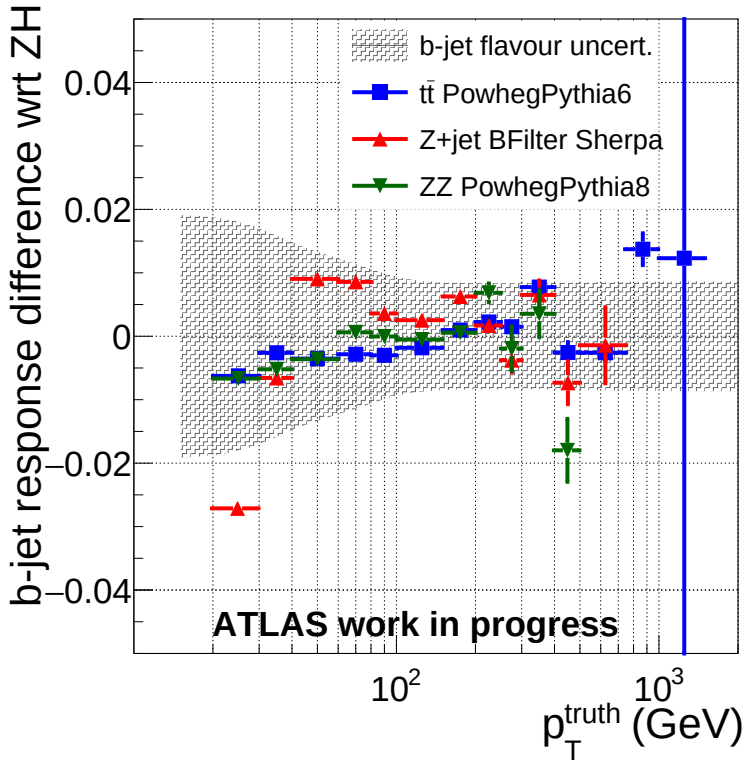


- b-jet response better with GSC by 2-4% (reduces flavour response difference).
- Jet energy resolution improved by around 20%.
- Resolution improvements in $M_{b\bar{b}}$ distribution up to 25%.

b-jet flavour systematic uncertainty

- b-jet flavour systematic uncertainty evaluated is due to:
  - different hadronization models, more or less parton shower.
  - different b-jet production processes (colour singlet, decay and gluon spliting)
- evaluated comparing the jet energy response for different MC samples.
- differences in response with respect to:
  left default $t\bar{t}$ MC (PYTHIA6).
  right ZH sample (PYTHIA8).





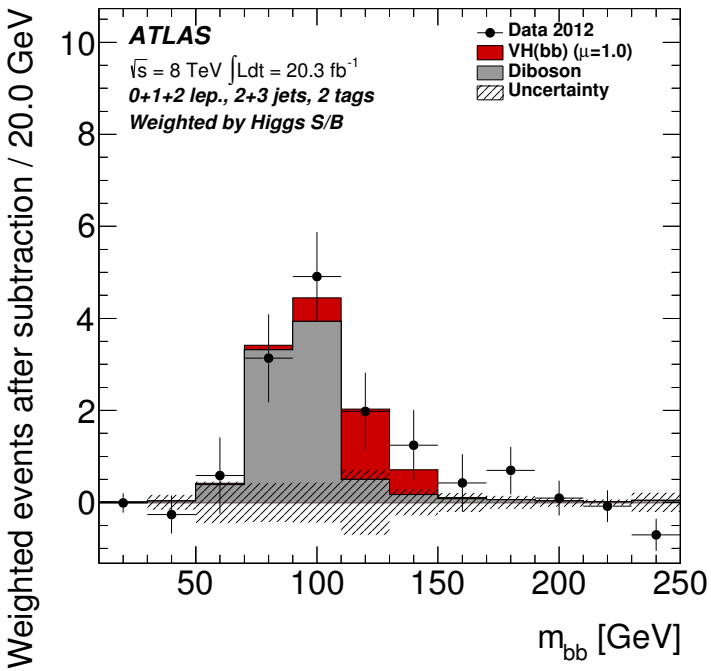
- Green band is the b-jet flavour uncertainty for the default ATLAS jet calibration.
  - Covers the differences observed
- No extra systematic uncertainty due to GSC was needed.

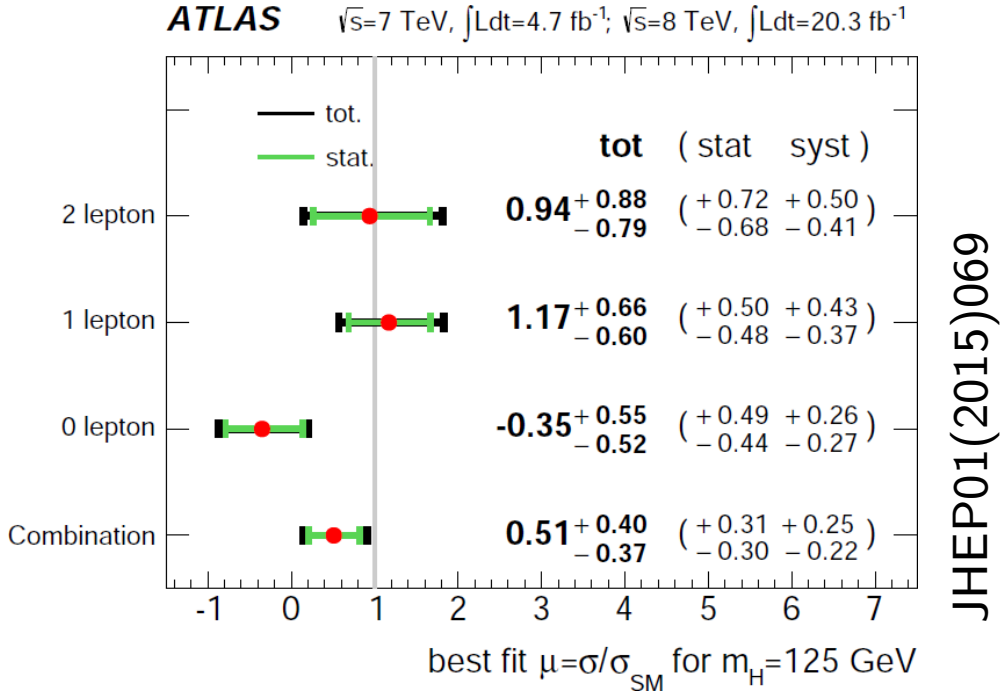
Conclusions and VH results

- GSC b-jet performance validated and tested for $M_{b\bar{b}}$ resolution improvement.
- Evaluated GSC b-jet specific systematic uncertainty.
  - Input for ZH analysis.

- Combination of all the VH analysis:

2-lepton $ZH \to \ell\ell b\bar{b}$ (this analysis)
1-lepton $WH \to \ell\nu b\bar{b}$ (more from Rute)
0-lepton $ZH \to \nu\nu b\bar{b}$





- Signal strength compatible with the Standard Model.
- Small excess of events after background subtraction:
  - observed (expected) significance of 1.4 (2.6).