Differential cross section study update

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Abstract

Recent results on coupling measurements in the bosonic decay modes have confirmed the Higgs-like properties of the boson discovered in 2012 by the ATLAS and CMS collabo- rations. Measurements of the Higgs decay products lend further insight into the underlying kinematic properties of the signal production and decay. With an accumulated integrated luminosity of 20.3 fb in 2012 and the high signal selection e ciency, the diphoton decay channel is ideally suited to measure these properties. In this supporting documentation, we present additional analysis details for the publi- cation presenting first measurements of fiducial cross-sections of the Higgs boson in the diphoton decay channel. The amount of background, mainly from SM diphoton production and hadronic jets, is determined by a simultaneous signal and background fit to the diphoton invariant mass spectrum.Comparisons between full simulation yy and AF2 yy ,AF2 yy w/w.o pileup weight and AF2 correction in different bins.

Contents

1 Introduction

Background modeling provide stable background function for signal fitting, so high-statistic background for bins of differential variables is needed to reduce statistic bias.To produce the minic background,there are four steps:get the yy component using the AF2 yy sample;use the data-driven(reverse ID) method to get the reducible components, get the ratio over AF2 yy shape in each bin;produce the high-statistics reducible components by using the ratio over AF2;mix the reducible and irreducible backgrounds using the purities from 2X2D method. During these steps,I do some detail checks on going:compare full simulation yy and AF2 yy in different bins;compare AF2 yy with and without pileup weight in different bins;compare AF2 correction in different bins.Here I mainly talk about my checks in report.And as there are many variables we interested in but they are all be deal with using the same strategies,I just take inclusive case and ptH catergories as the examples.

2 Details checks on going

2.1 Compare full simulation yy and AF2 yy in different bins

In Figure 1,I draw the yy events distributions of full yy simulation and fast yy simulation,we can see that they are approximately accordant in most range, so wo can use AF2 yy replacing full simulation yy to get high-statistic yy component.Still there are Ptyy catergories comparisons in different bins(In Figure 2).

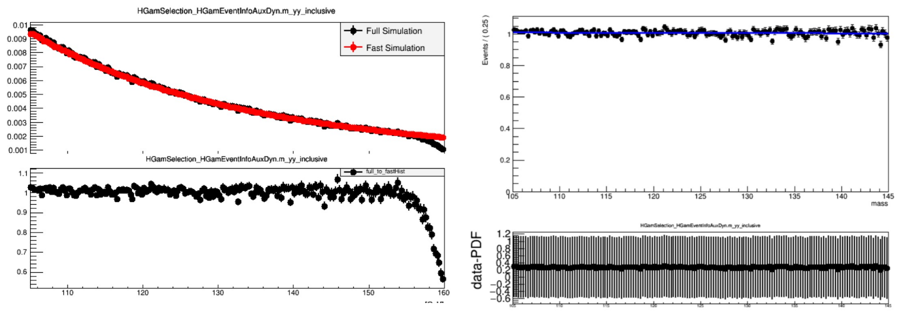

Figure 1: Comparison between full yy simulation and AF2 yy for inclusive case.

2.2 Shape comparison with and without Pileup weight in different bins

In Figure 3,the left figure shows the AF2 shape w/ w.o pileup weight and its ratio , the right figure shows its linear fit. There is tiny difference between them..We can get high-statistic yy component without pileup weight.Still there are Ptyy catergories comparisons in different bins(In Figure 4).

2.3 Compare fastyy simulation correction in different bins

In Figure 5,I apply a truth cut at 158GeV,then there is a obvious decrease.In Figure 7,I get the ratio of no truth cut / with 158GeV truth cut and we can get a increasing ratio.Similarly,I use the same way at 107 GeV.We can also see a obvious dip due to the truth cut and increasing ratio(In Figure **??** and Figure 8).Finally,I get the correction ratio of full mass range(In Figure 9).Still,I use the same strategies to get Ptyy correction in different bins(In Figure 10).We can see from this figure that ptHBin2 and ptHBin5 may have more difference compared with others. And we can get the conclusion that : Inclusive correction and Ptyy correction are approximately accordant, so we can use inclusive correction ratio to correct different variables.

3 Correction for Detector effect of differential cross section

I give the preliminary results about the binbybin results, next step,I will use the common tool to do the different unfolding method comparison. As we all know that Bin-by-bin correction is used to correct the detector effct,so firstly I learn something about it. Here is the reco-levels event selections and object selections.
I.reco-level selection 1.event selection: (1)GRL; (2)Pass Trigger; (3)Detector DQ; (4)Has PV; (5)2 Loose Photons:ET greater than 25 GeV and —— less than 2.37 ; (6)e Ambiguity; (7)Trigger Matching; 2.object selection (1)Photon selection: Tight ID; Isolation: Ptcone20 greater than 0.05*pt and Etcone20 less than 0.065*pt; Kinematic cuts : pT greater than 25 GeV and —— less than 2.37; Leptons selection : ET greater than 15 GeV and ——Jets selection : pT greater than 30 GeV and —y— less than 4.4 ; Jets selection : pT greater than 30 GeV and —y— less than 4.4 ;
II.truth-level selection 1.object selection (1)Photons: Identified by requiring PdgId equal to 22; (2)Kinematic photon cuts:pT greater than 25 GeV and —— less than 2.37 ; (3)isolation:ptcone20 less than 0.05*pt; (4)Leptons selection: Identified by requiring —PdgId— equal to 11 for electrons or —PdgId— equal to 13 for muons. pT greater than 15 GeV and —— less than 2.47 ; (5)Jets selection: rejected if they lie within R less than 0.2 of a selected photon or R less than 0.4 of a selected electron; (6)overlap removal : Electrons within dR(e,ys) less than 0.4 are removed; Jets within dR(jet,es)less than 0.2or within dR(jet,ys)less than 0.4 are removed; Muons within dR(, ys) less than0.4 are removed;

3.1 Bin-by-bin correction factor

Figure 11 is the defination of Bin-by-bin correction factors.

And I draw the correction factors of different variables, here are inclusive,pyjet1 and ptyys example(Figure 12).

3.2 Purity and Efficiency

The purityP, and efficiency, , in each bin are defined as Figure 13.
And I draw the efficiency(Figure 14) and purity(Figure 13) of inclusive,pyjet1 and ptyys examples.

3.3 Migration

Another important defination is migration. The migration matrices for each variable, which show the degree of migration of events between bins of the distribution between truth and reco level. Here are the migrations of inclusive,pyjet1,ptyy(Figure 16).

4 Summary

I want to give a summry of what I did. I have compared the Full Simulation yy and AF2 yy sample, the shapes are nearly the same;Compared the AF2 yy shape w/w.o Pileup weight, the difference is tiny. Drop the pileupweight to get high statistic sample;Compared the inclusive AF2 yy correction with the corrections in differential bins, can use the inclusive correction in differential bins directly.And next step,I will use the common tool to do the different unfolding method comparison.

Finally,thanks for the help of my supervisors,Yanping Huang and Cong Peng.And also thanks for the persons who give me help in DESY.

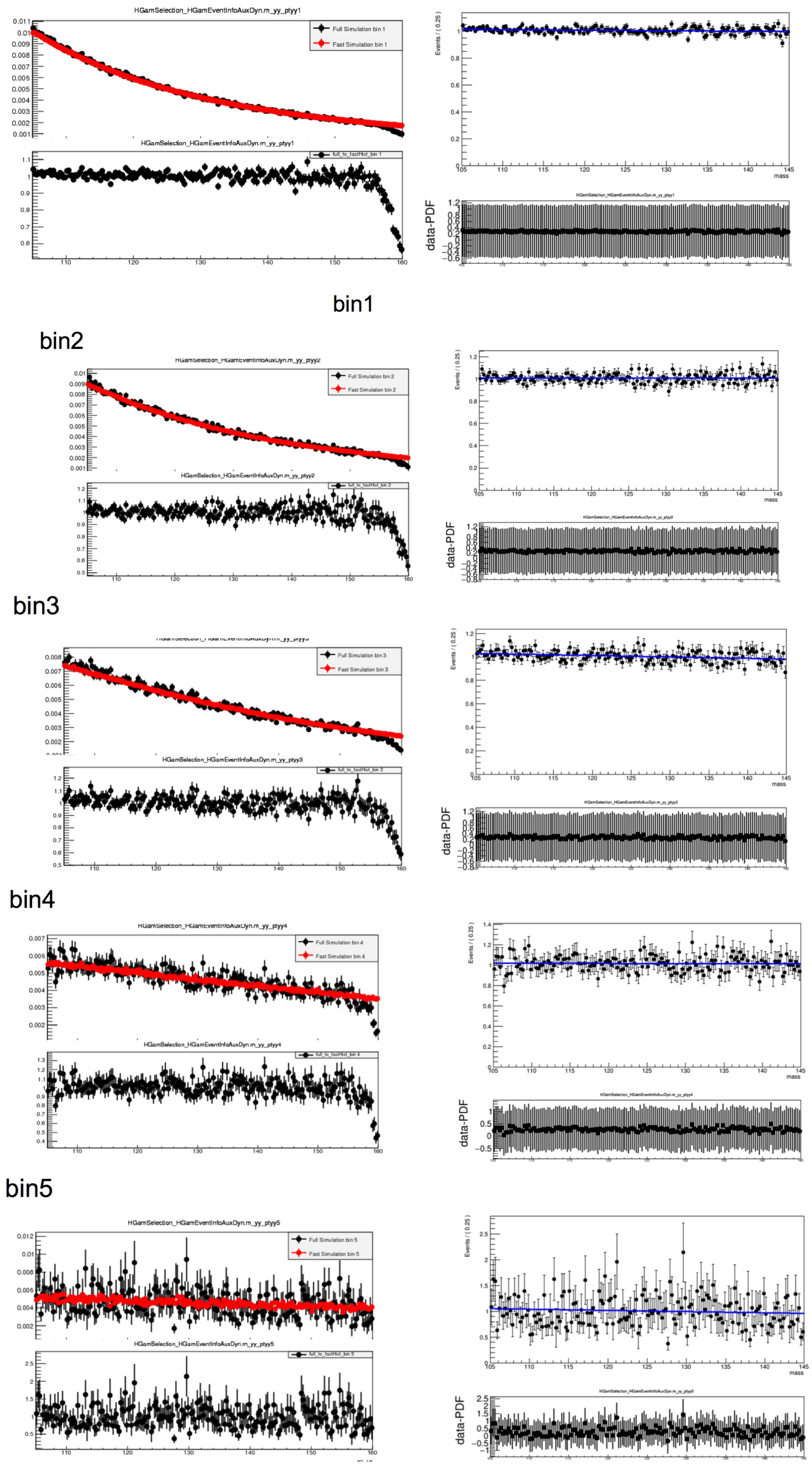

Figure 2: Comparison between full yy simulation and AF2 yy for ptyy catergories.

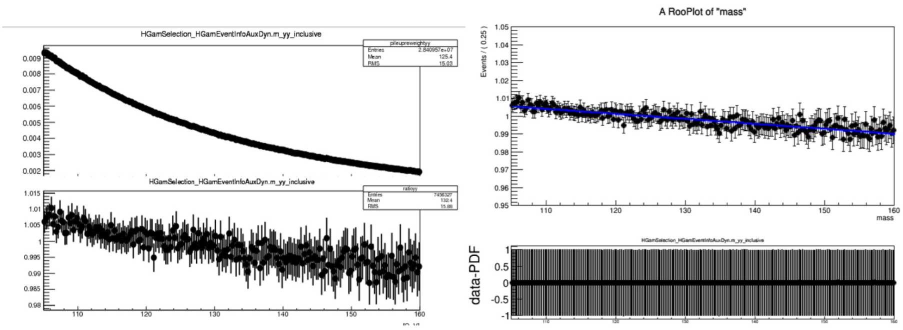

Figure 3: Shape comparison with and without Pileup weight for inclusive case.

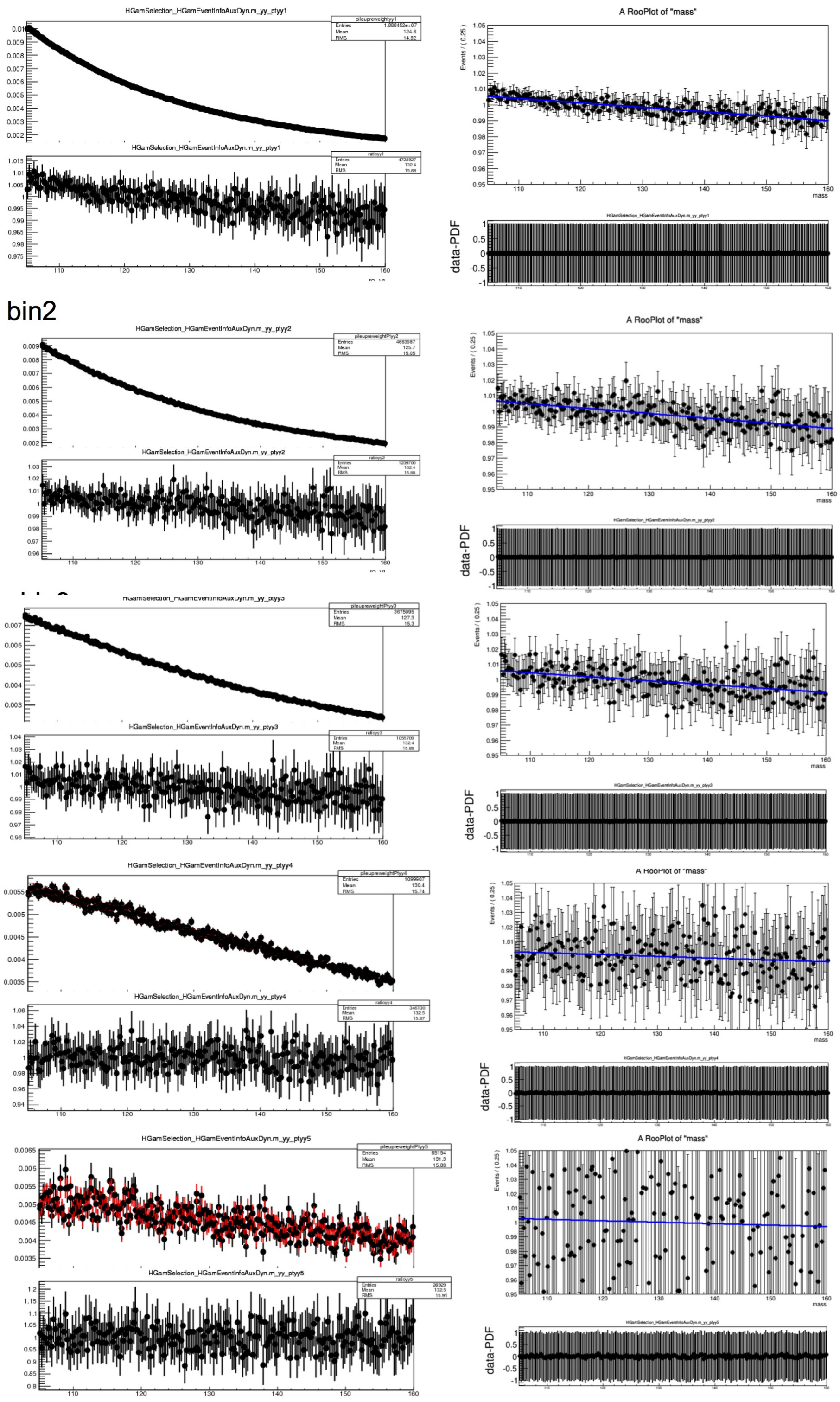

Figure 4: Shape comparison with and without Pileup weight for ptyy categories.

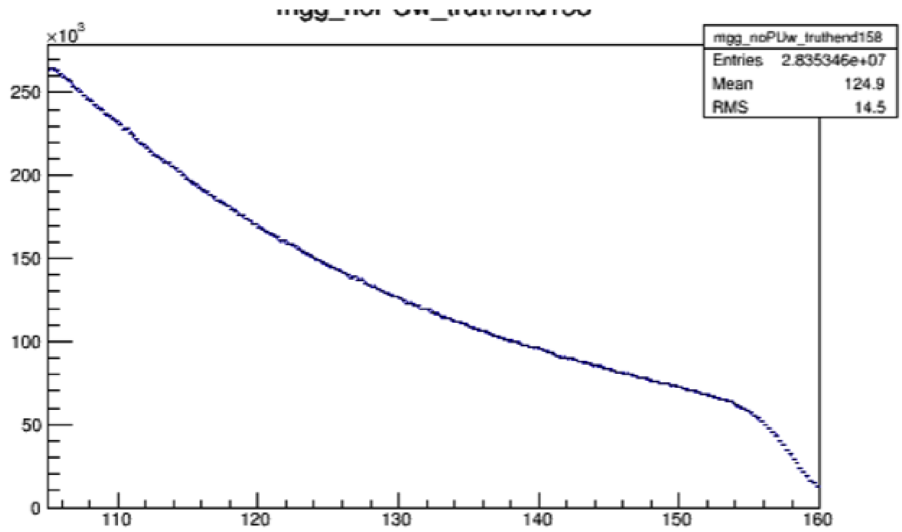

Figure 5: Apply a truth cut at 158GeV

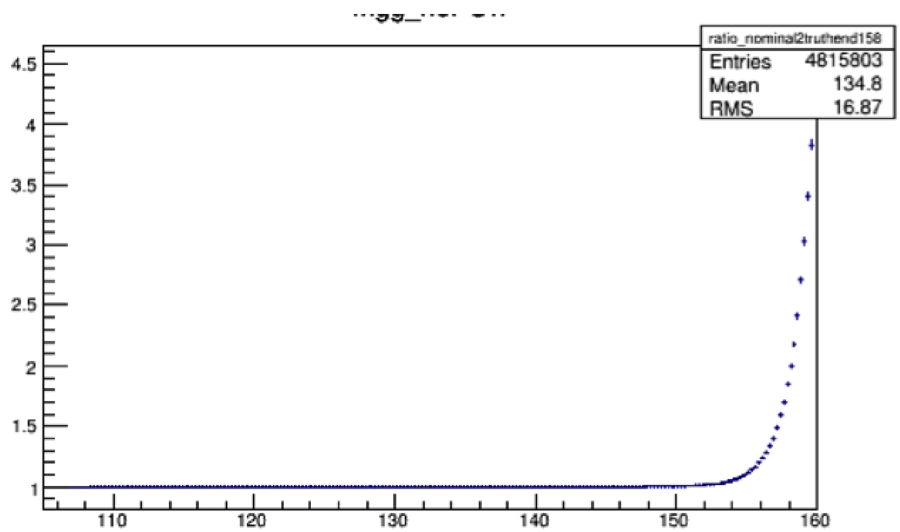

Figure 6: The ratio of no truth cut / with 158GeV truth cut

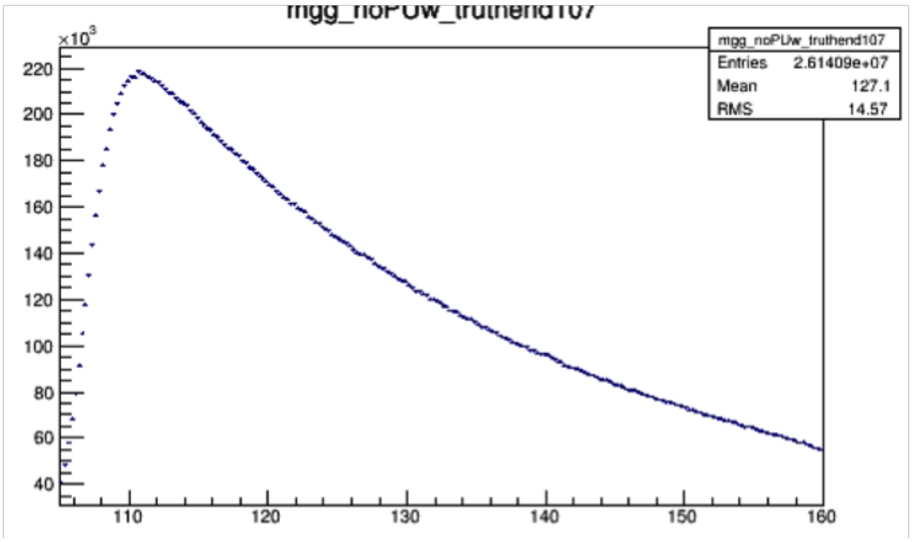

Figure 7: Apply a truth cut at 107GeV

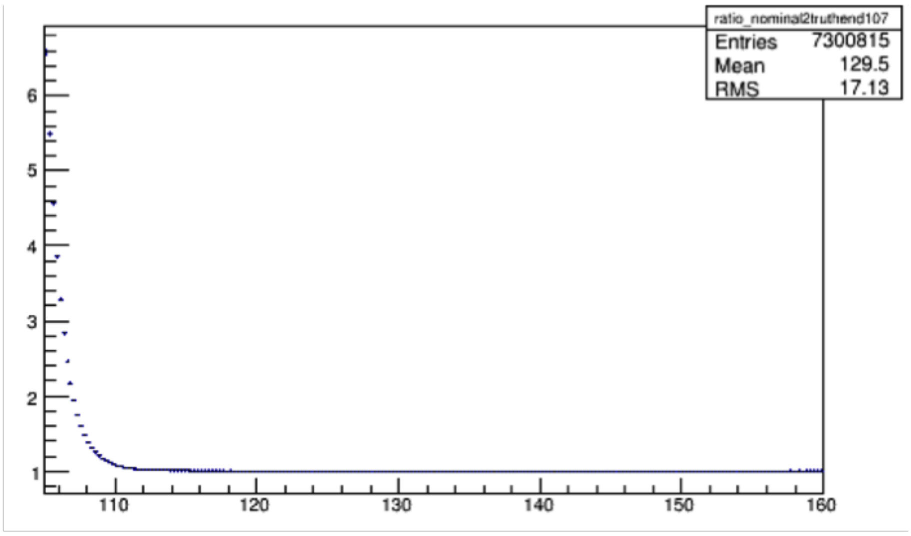

Figure 8: The ratio of no truth cut / with 107GeV truth cut

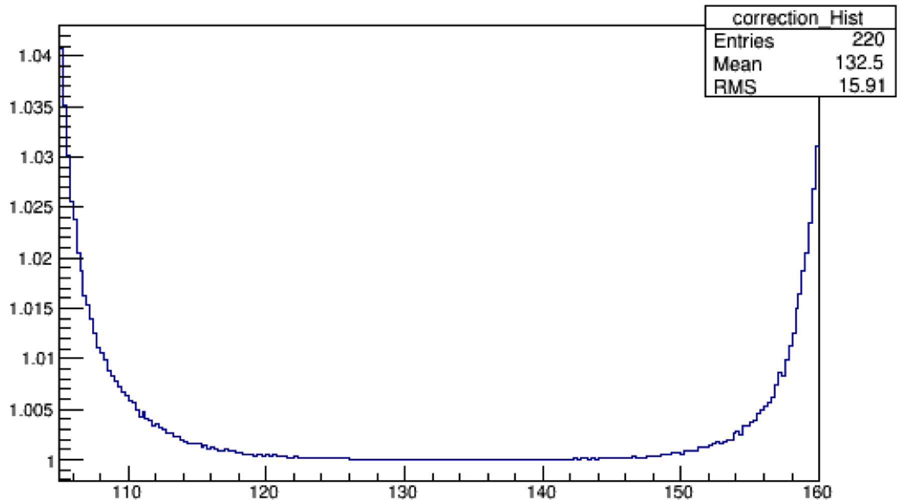

Figure 9: Get the correction ratio of full mass range for inclusive case.

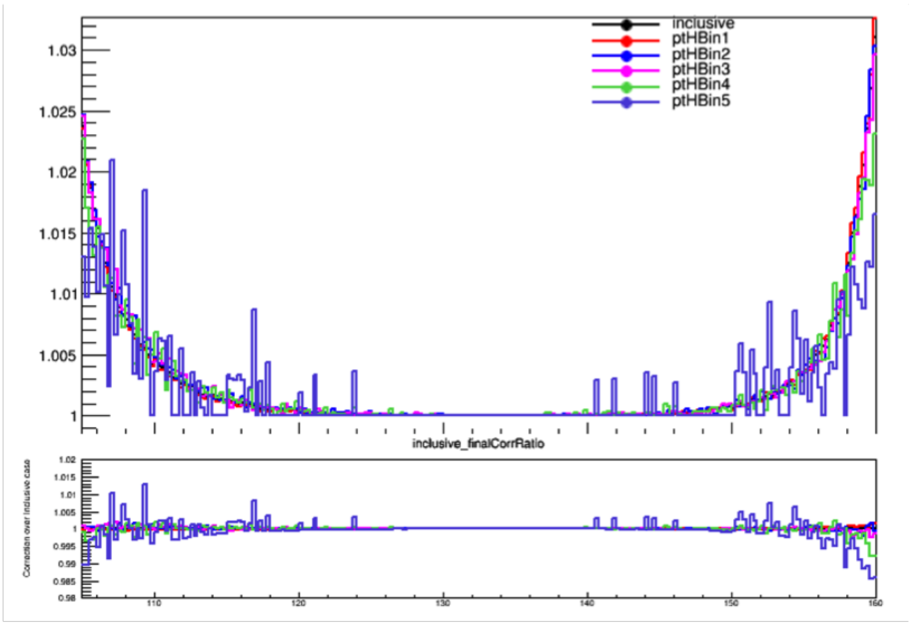

Figure 10: Comparison between the correction ratio of full mass range for ptyy categories and inclusive case.

$$c_i = \frac{n_i^{part}}{n_i^{det}} \qquad n_i^{data,part} = c_i n_i^{data}$$

Figure 11: The defination of Bin-by-bin correction factors.

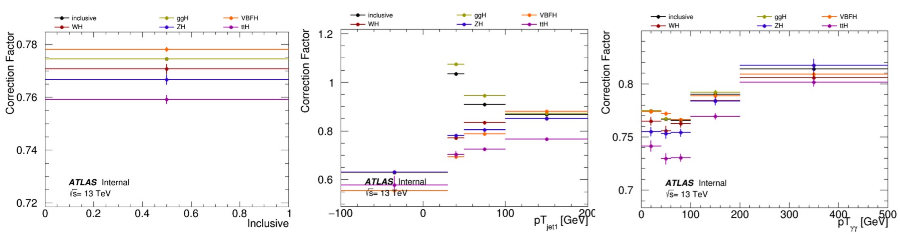

Figure 12: The correction factor of inclusive,pyjet1 and ptyys examples.

$$p_i = \frac{n_i^{det,part}}{n_i^{det}} \qquad \varepsilon_i = \frac{n_i^{det,part}}{n_i^{part}}$$

Figure 13: The defination of purity and efficiency.

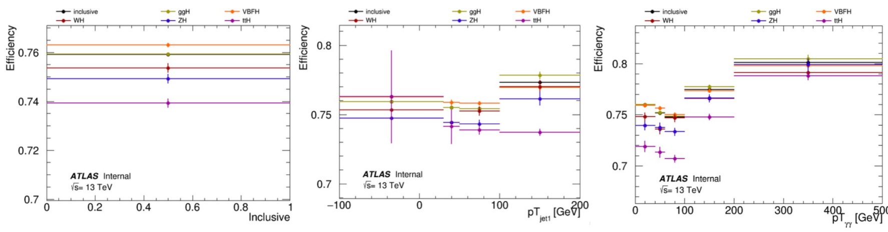

Figure 14: The efficiency of inclusive,pyjet1 and ptyys example.

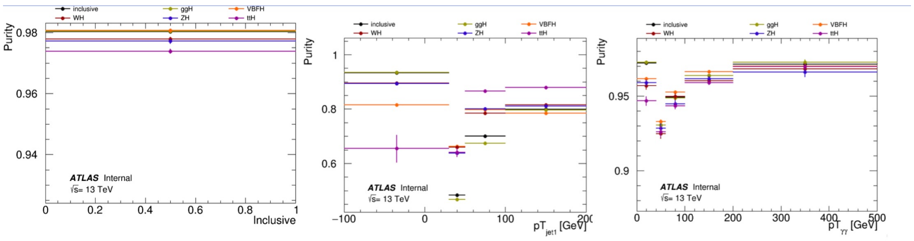

Figure 15: The purity of inclusive,pyjet1 and ptyys examples.

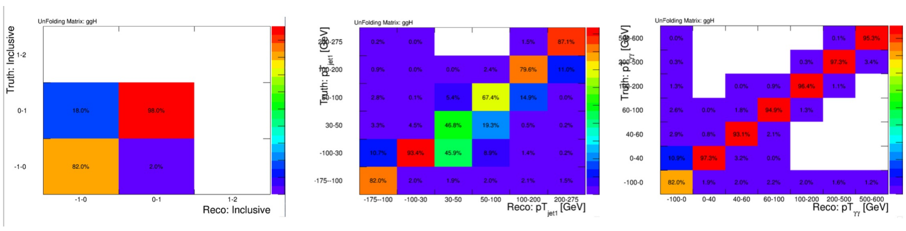

Figure 16: The migration of inclusive,pyjet1 and ptyys examples.

References

[1] Measurement of fiducial and differential cross sections of the Higgs boson in the diphoton decay channel using 8 TeV pp data Publication supporting documentation *ATLAS Note*

[2] *ATLAS Note*