13TeV VBF H->$\gamma\gamma$ Analysis

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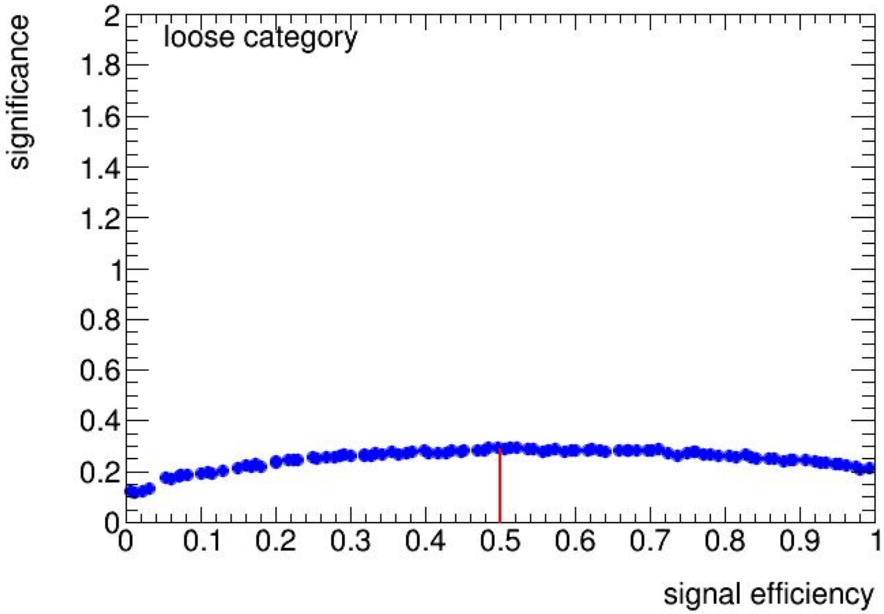
11.16

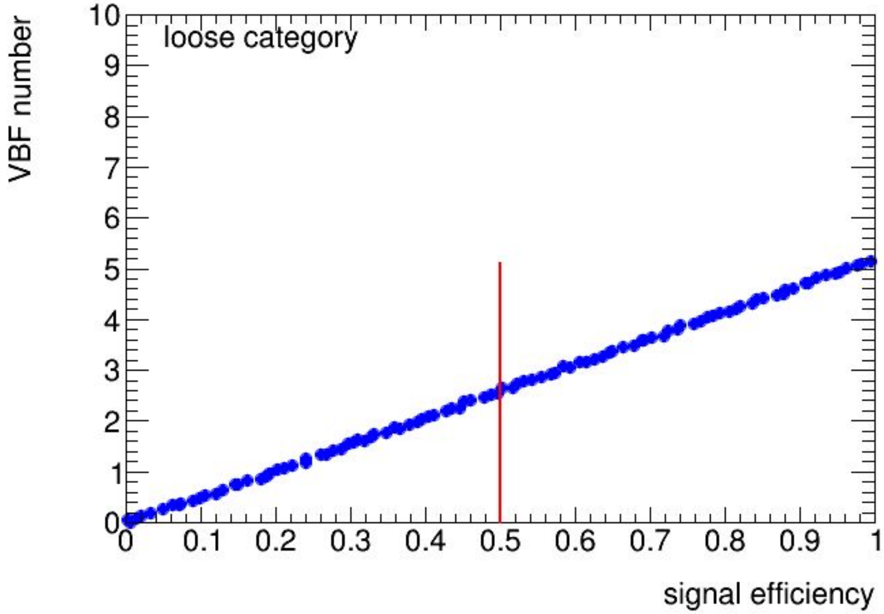
introduction

- data
  - total:3.34/fb in final GRL
  - begin to produce MxAOD by myself
- cut-based
  - fix the bug
- MVA
  - correlation
- document

cut-based

- bug
  - train with events failing tight selection
  - tight:mjj>500GeV,Δηjj>3.9,ΔΦγγ,jj>3,$\Delta R^{min}_{\gamma,j}$>1.4,η*>2.4
  - wrong:m_{jj}<500GeV,$\Delta\eta_{jj}$<3.9,$\Delta\Phi_{\gamma\gamma,jj}$<3,$\Delta R^{min}_{\gamma,j}$<1.4,η*<2.4
  - correct:!(mjj>500GeV,Δηjj>3.9,ΔΦγγ,jj>3,ΔRminγ,j>1.4,η*>2.4)
  - loose:mjj>350GeV,Δηjj>2.5,ΔΦγγ,jj>2.7



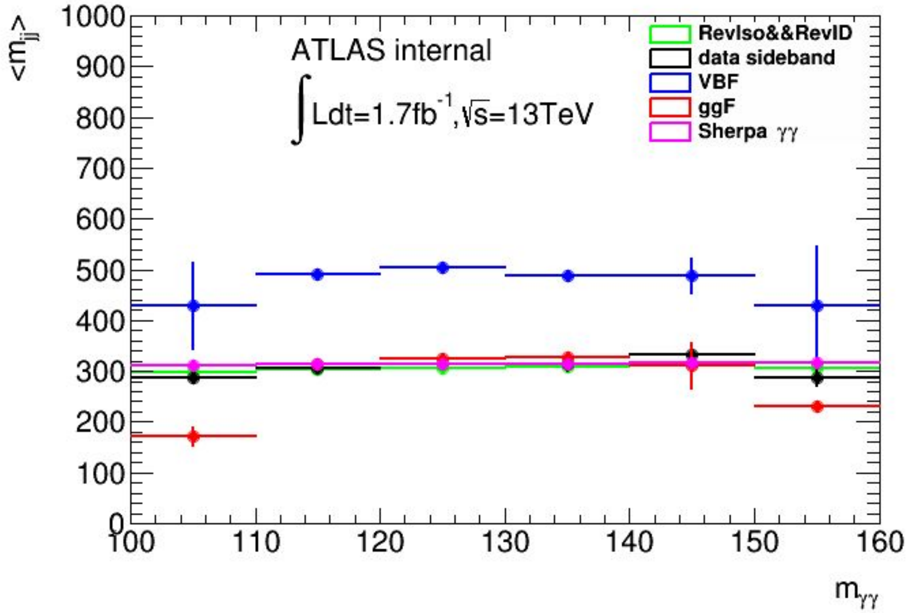


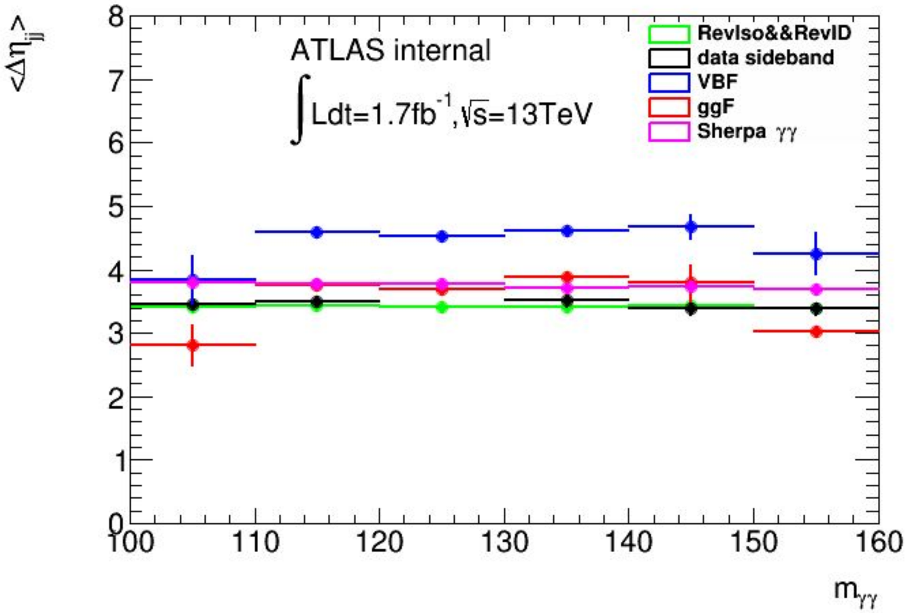
comparison

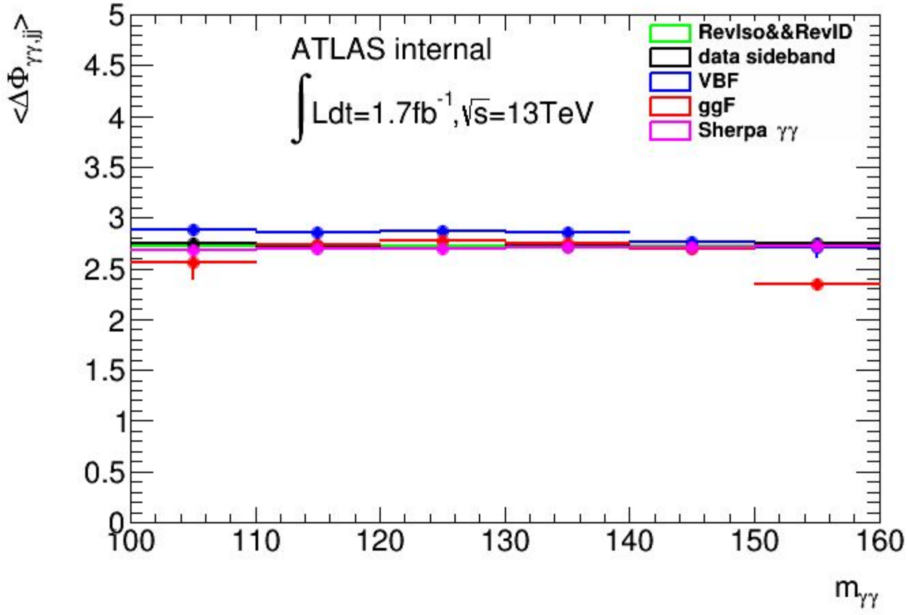
	cut-based tight	cut-based loose	MVA tight	MVA loose
VBF	2.22	2.32	2.31	2.29
ggF	0.83	2.94	0.54	2.12
background	8.06	59.73	3.37	23.17
VBF purity	0.73	0.44	0.77	0.52
significance	0.72	0.29	0.84	0.45
combined significance	0.78		0.95	

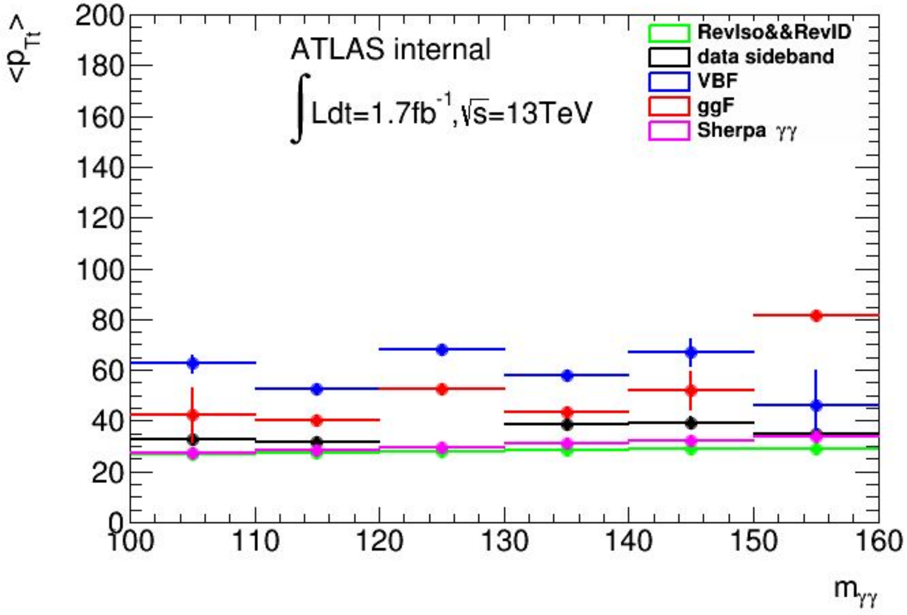
21% improvement

correlation

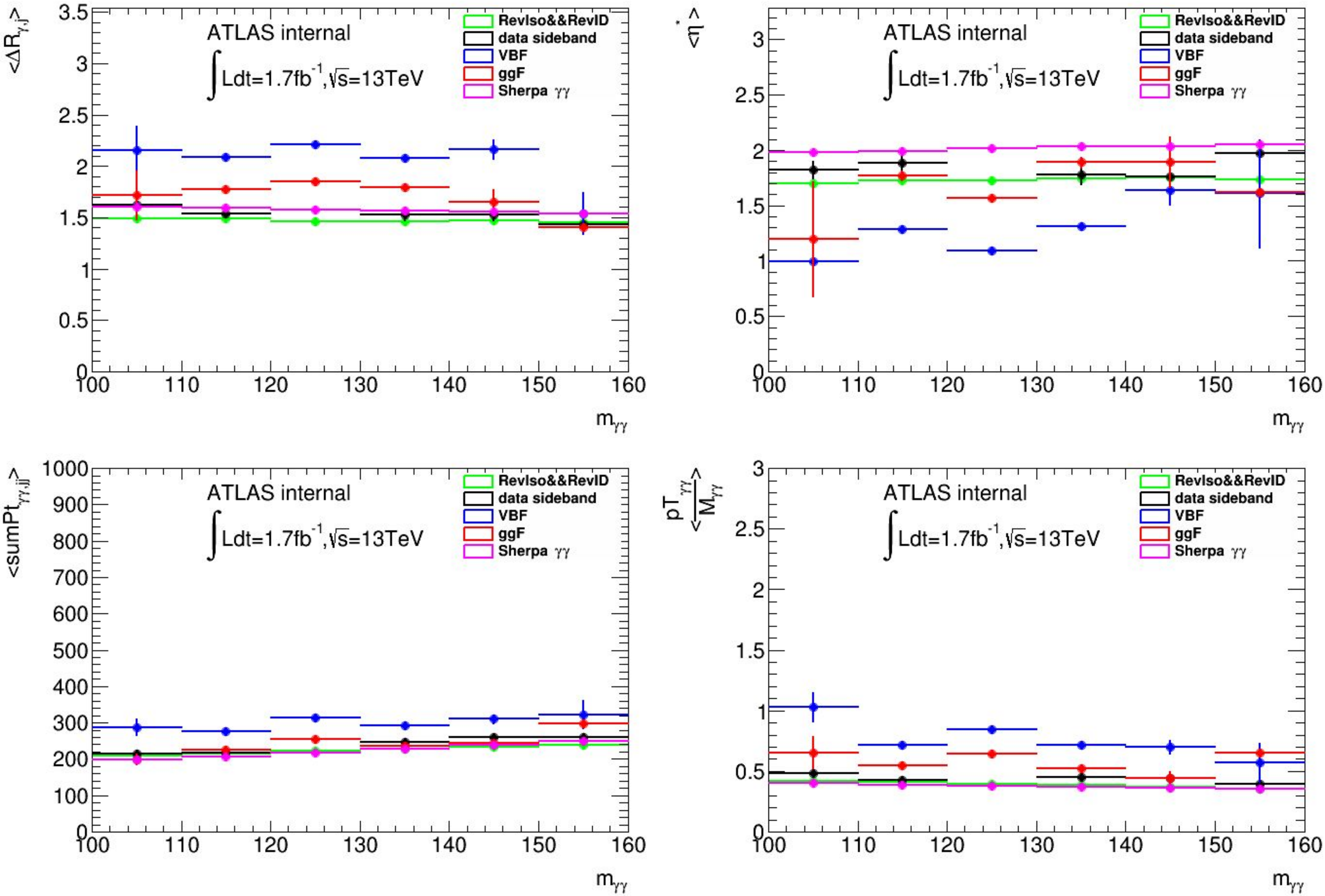








correlation



document

- have submitted
- wait for feedback
- implement some other checks and sections

Contents

5 VBF category optimization

The VBF process has an unique signature,with two forward jets and little QCD radiation in the central region from hard interaction.

The main non-resonant background in VBF H $\rightarrow \gamma\gamma$ is from Standard Model QCD process:$\gamma\gamma$ pairs in association with at least two jets,single γ events with at least three jets of which one jet fakes a photon,and multi-jet events where two jets fake two photons.Another important background to VBF Higgs $\gamma\gamma$ is resonant ggF Higgs $\gamma\gamma$ in association with at least two jets.Here Sherpa samples of $\gamma\gamma$ plus jets are used to simulate $\gamma\gamma$ plus jets background.γ+jet and jet-jet background are estimated by reverse identification(RevID) and reverse isolation(RevIso) samples from data,which are required to have one or two photons fail photon identification or isolation.

5.1 Variable selection

Compared with background events,di-jet of VBF signal is in forward region with hight transverse momentum and large rapidity separation.The decay products of Higgs lie in the central-rapidity region.Some discriminating variables are given from this unique angle correlation.Following variables are used in Run1 analysis in table 1 and the distribution is showed in figure 1 after VBF preselection,which requires at least two jets and $\Delta\eta_{jj} > 2, \eta^{Zeppenfeld} < 5$.

Variables	Definition
m_{jj}	Invariant mass of dijet
$\Delta\eta_{jj}$	Pseudo-rapidity separation of dijet
$\Delta\Phi_{\gamma\gamma.jj}$	Azimuthal angle between diphoton and dijet system
p_{Tt}	Diphoton p_T projected perpendicular to the diphoton thrust axis
$\Delta R^{min}_{\gamma.j}$	Minimum ΔR between either leadingsubleading photon and leadingsubleading jet
$\eta^{Zeppenfeld}$	$\lvert\eta_{\gamma\gamma} - 0.5 * (\eta_{j1} + \eta_{j2})\rvert$

Table 1: variables and their definitions

5.2 Optimizing the combination of input variables

Some other variables are introduced to discriminate VBF signal from ggF background and non-resonant background.The relevant system is listed in table 2.Some variables of each system is concerned ,such as p_T,scalar sum of p_T,scalar sum of momentum,invariant mass,pseudo-rapidity,$\Delta p_T, \Delta\Phi, \Delta R, p_T/P, E, E/M$, $p_{T\gamma 1}/m_{\gamma\gamma}, p_{T\gamma 2}, p_{T\gamma\gamma}$ are also included

A method is introduced for variables selection.Fisrt,all of the variables are put in the training and ranked by their separation power,defined by equation 1.Second ,if some variables are highly correlated,only the one with highest separation power are kept.Then ,variables highly correlated to $m_{\gamma\gamma}$ are removed in case that variables will change the distribution of $m_{\gamma\gamma}$.Finally,check the systematics and find the best combination of variables.

Some powerful variables and its separation power and correlation are listed in table 3.The distribution is shown in figure 2

$$< S^2 >= \int \frac{(\hat{y_s}(y) - \hat{y_b}(y))^2}{\hat{y_s}(y) + \hat{y_b}(y)} dy \quad (1)$$

derivation

- help to submit jobs and update twiki
- HIGG1D1 skimming
  - γ:goodOQ,loose,pT>20GeV,|η|<2.47,remov crack region
  - e:loose,pT>20GeV,|η|<2.47,remov crack region
  - mu:pT>20GeV,|η|<2.7
  - keep events with $\gamma\gamma$,ee,1e1γ,1mu1γ
- our WW$\gamma\gamma$ analysis can start from DAOD HIGG1D1

to do list

- check the systematics of different variable combination