13TeV VBF H->γγ Analysis

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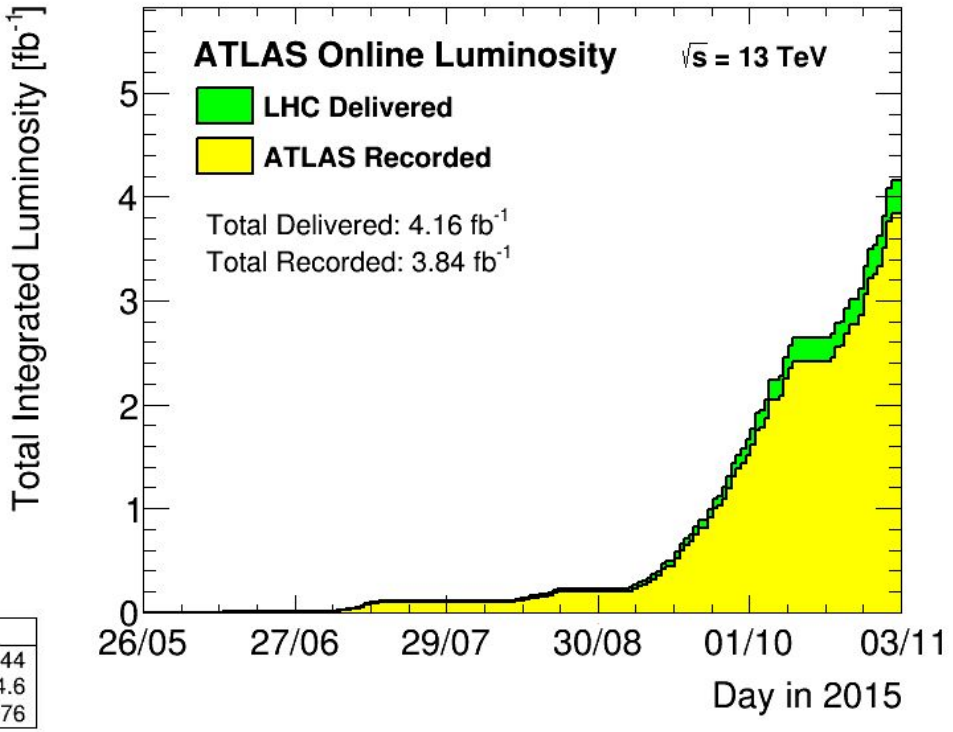
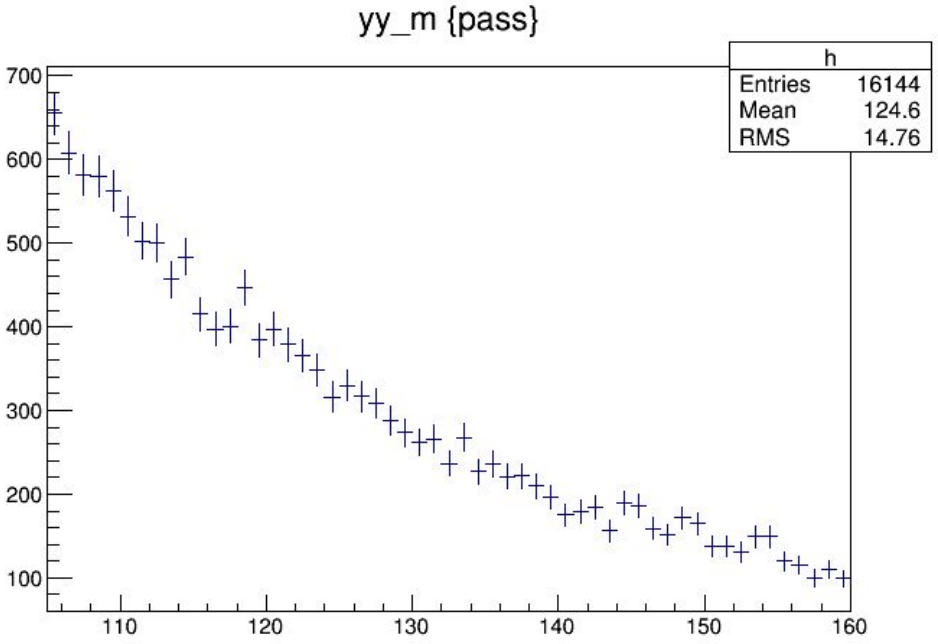
11.02

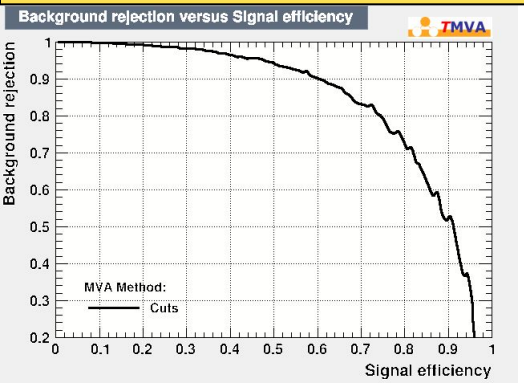
introduction

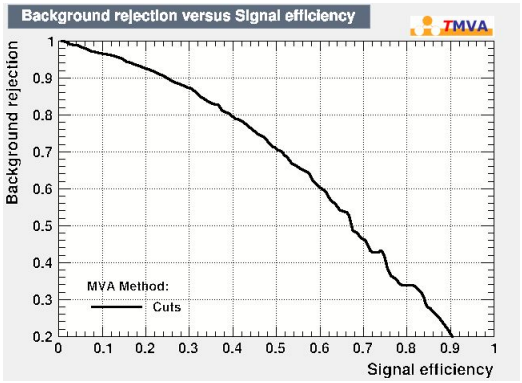
- data
  - total: 3.84fb^{-1}
  - available: 1.99fb^{-1}
  - inclusive: 16144
  - VBF pre: 1521

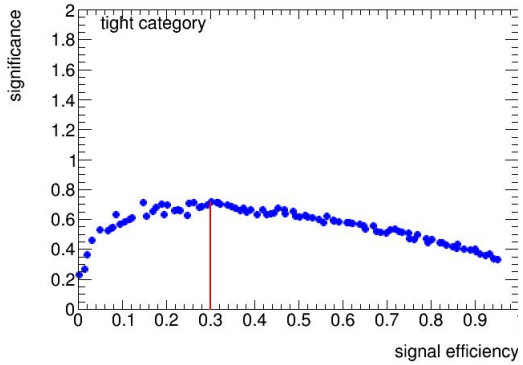


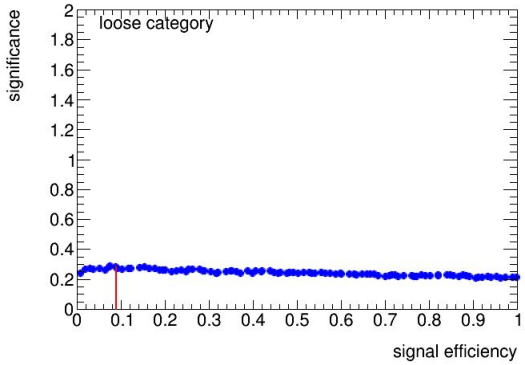


cut-based optimization









- not sure whether VBF preselection should be applied
- these plot is with VBF preselection
- A comparison is showed in next slide
- $\Delta\eta_{jj}>2,\eta^*<5$

- Selection:

  tight:$m_{jj}>500GeV,\Delta\eta_{jj}>3.9,\Delta\Phi_{\gamma\gamma,jj}>3,\Delta R_{\gamma,j}^{min}>1.4,\eta^*<2.4$

  loose:$m_{jj}>310GeV,\Delta\eta_{jj}>2.5,\Delta\Phi_{\gamma\gamma,jj}>2.7$
- run1tight:$m_{jj}>520GeV,\Delta\eta_{jj}>2.8,\Delta\Phi_{\gamma\gamma,jj}>2.6,\Delta R_{\gamma,j}^{min}>2,\eta^*<2.4$

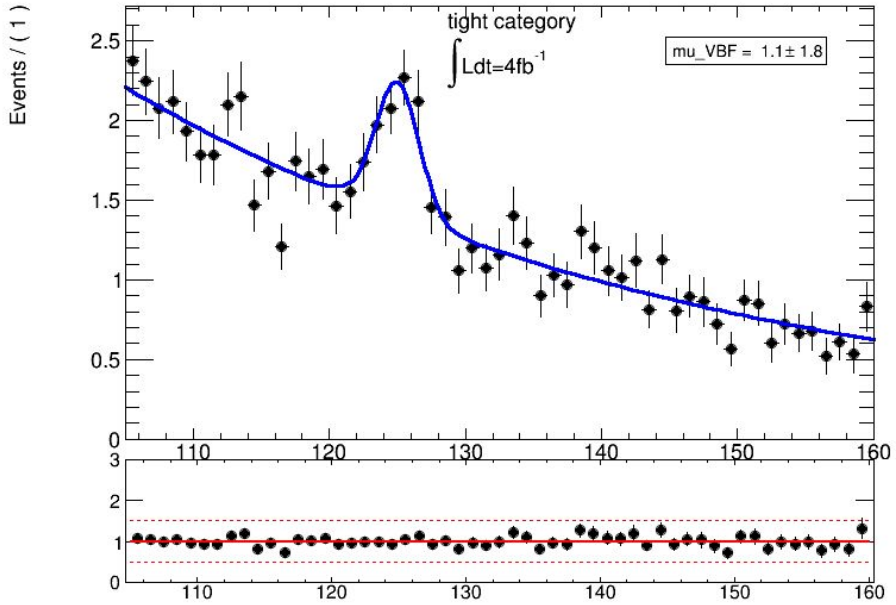
  loose:$m_{jj}>400GeV,\Delta\eta_{jj}>2.8,\Delta\Phi_{\gamma\gamma,jj}>2.6$

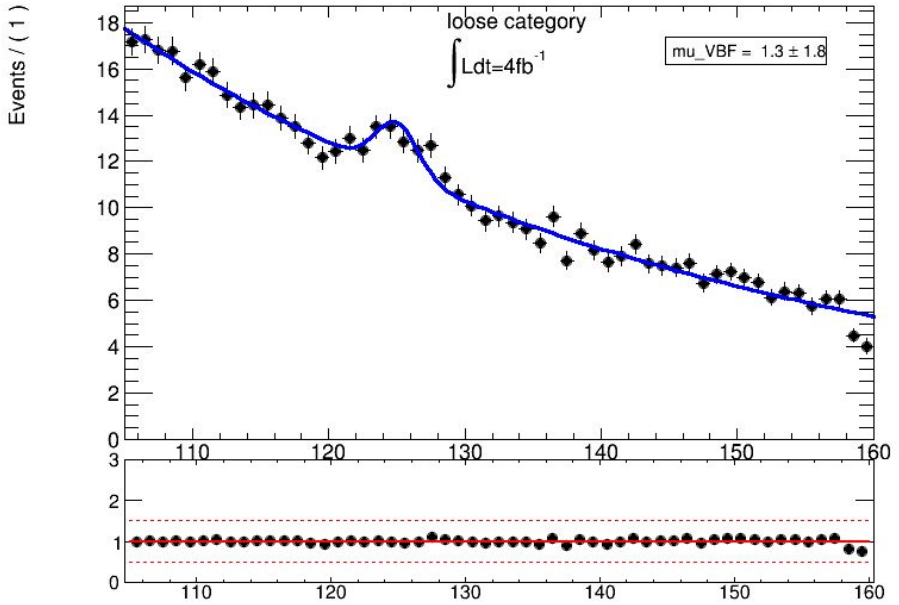
comparison

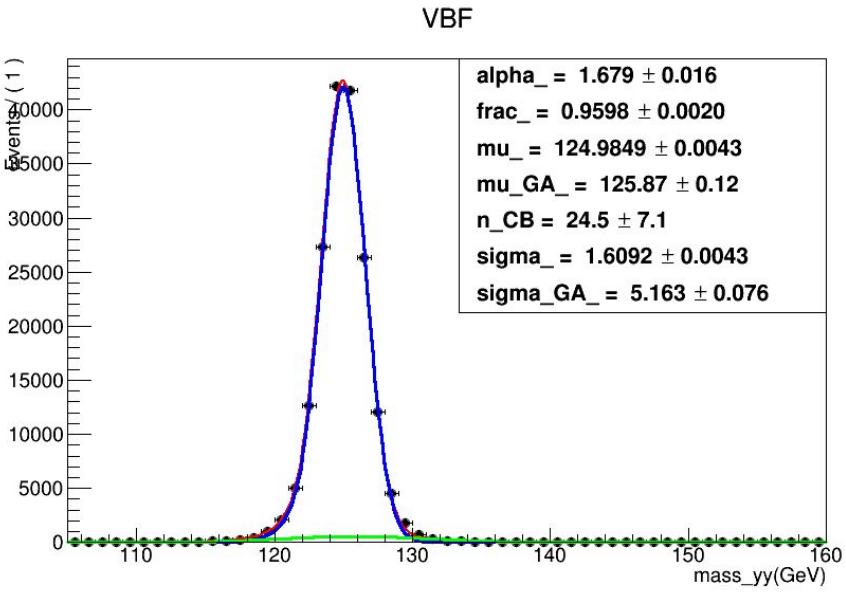
	with VBF preselection		without VBF preselection	
	cut-based tight	cut-based loose	cut-based tight	cut-based loose
VBF	2.22	2.57	2.24	3.21
ggF	0.83	3.51	0.89	4.91
bkg	8.06	74.74	8.25	111.58
VBF purity	0.73	0.42	0.72	0.40
significance	0.72	0.29	0.71	0.30
combined	0.78		0.77	

- with VBF preselection
  - tight:m_{jj}>500GeV,$\Delta\eta_{jj}$>3.9,$\Delta\Phi_{\gamma\gamma,jj}$>3,$\Delta R_{\gamma,j}^{min}$>1.4,$\eta^*$<2.4
  - loose:m_{jj}>310GeV,$\Delta\eta_{jj}$>2.5,$\Delta\Phi_{\gamma\gamma,jj}$>2.7
- without VBF preselection
  - tight:m_{jj}>600GeV,$\Delta\eta_{jj}$>1.7,$\Delta\Phi_{\gamma\gamma,jj}$>3,$\Delta R_{\gamma,j}^{min}$>1.8,$\eta^*$<2.4
  - loose:m_{jj}>300GeV,$\Delta\eta_{jj}$>1.4,$\Delta\Phi_{\gamma\gamma,jj}$>2.5

fit with cut-based category







new variables

- related systems

	γ1	γ2	γ1γ2
j1	γ1 j1	γ2 j1	γ1 γ2 j1
j2	γ1 j2	γ2 j2	γ1 γ2 j2
j1 j2	γ1 j1 j2	γ2 j1 j2	γ1 γ2 j1 j2

- related variables : system pT,sum of pT,sum of P , mass,Eta,ΔpT,$\Delta\Phi$,ΔR,pT/P of system,E,E/M
- addtional variables:$pT_{\gamma 1}/m_{\gamma\gamma}$,$pT_{\gamma 2}/m_{\gamma\gamma}$,$pT_{\gamma\gamma}/m_{\gamma\gamma}$,$\eta_{j1}*\eta_{j2}$
- variable selection
  - loop all variables ,rank them by separation power
  - keep the most powerful one if varialbes are correlated
  - remove variables that correlates to m$\gamma\gamma$
  - find the best combination

MVA optimization strategy

- People ask me why ggF is not included in MVA training
- strategy 1(now)
  - train with $\gamma\gamma$,γj,jj and VBF samples and calculate BDT responce
  - scan BDT cut and obtain the work point with highest significance
- strategy 2
  - train with $\gamma\gamma$,γj,jj and VBF samples and calculate diphoton BDT
  - train with ggF and VBF samples and calculate ggF BDT
  - do optimization with a 2D scan of diphoton and ggF BDT
- strategy 3
  - train with $\gamma\gamma$,γj,jj and VBF samples and calculate diphoton BDT
  - train with ggF and VBF samples and calculate ggF BDT
  - give a final BDT with diphoton and ggF BDT and some other variables
- maybe need to test all of them ,not sure

bkg decoposition

- From Jim Lacey
- our modeling
  - γj:one photon fails tight ID in RevID&RevIso
  - jj:both photons fail tight ID in RevID&RevIso
- take Sherpa as γγ bkg(contributes 80%)
- take RevID&RevIso as γj and jj(contributes 20%)

13 TeV background decomposition

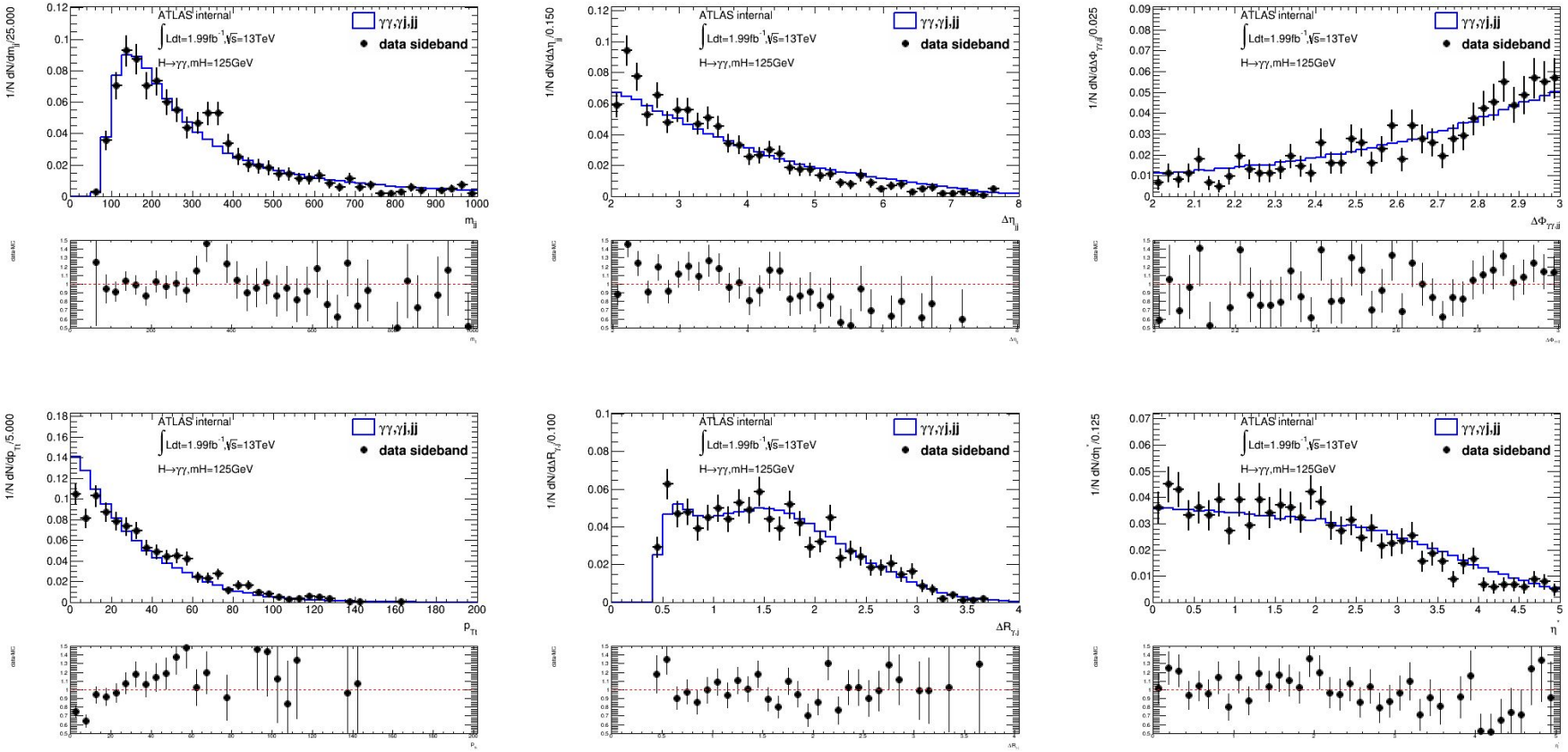
8 TeV

	γγ [%]	γ+jet [%]	jet+jet [%]
inclusive	77±3	20±2	3±1
$N_{jets} = 0$	75±2	22±2	3±1
$N_{jets} = 1$	81±2	18±2	2±1
$N_{jets} = 2$	85±2	14±2	1±1
$N_{jets} \geq 3$	85±2	14±2	1±1

13 TeV

	γγ [%]	γ+jet [%]	jet+jet [%]
inclusive	78±3	20±3	3±1
$N_{jets} = 0$	74±4	23±4	3±1
$N_{jets} = 1$	81±3	17±2	3±1
$N_{jets} = 2$	80±3	18±3	2±1
$N_{jets} \geq 3$	80±4	19±5	1±1

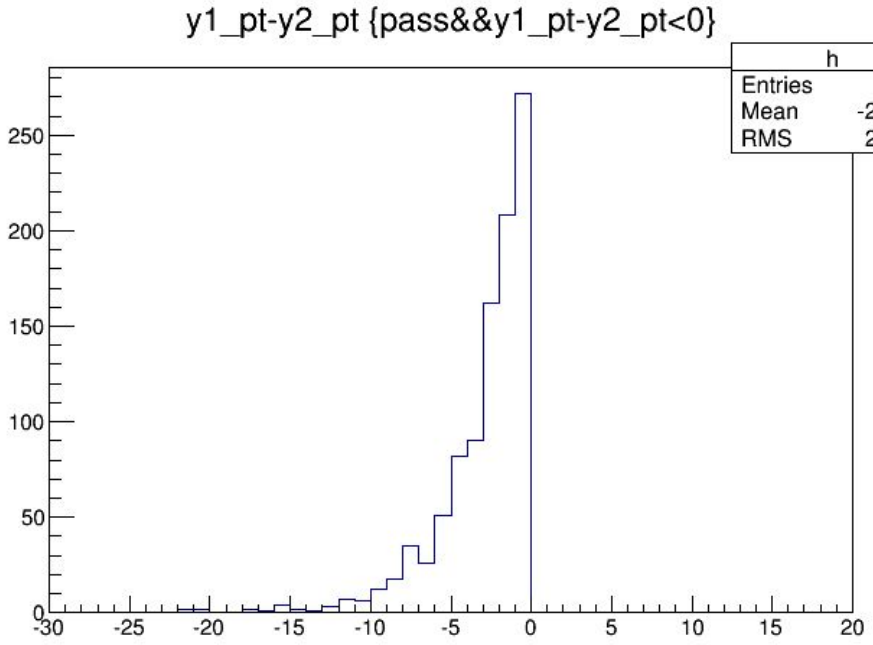
for now ,PID is not saved in my private Ntuple!

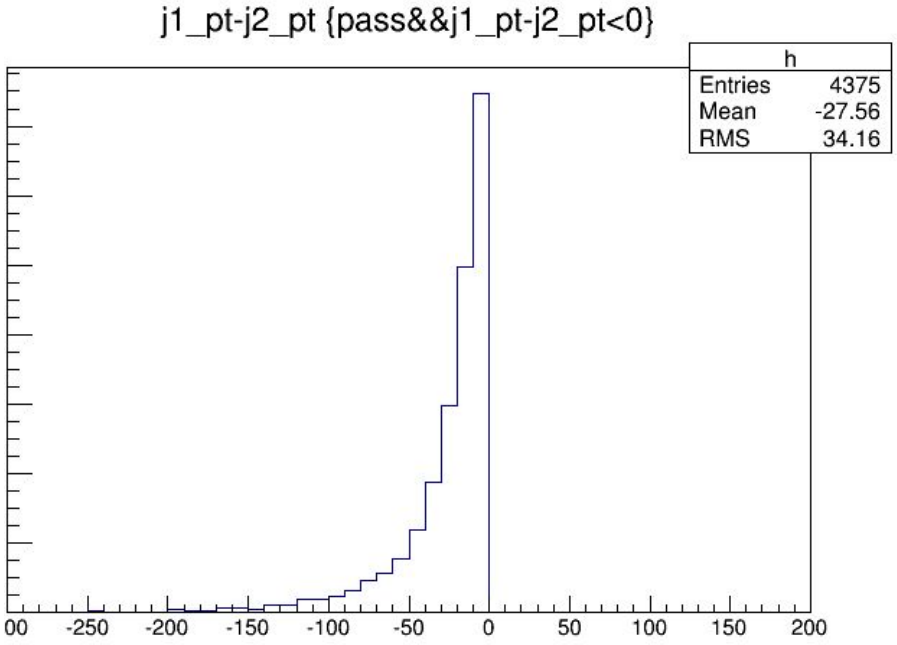


- In plot of m_{jj} ,$\Delta\eta_{jj}$,p_{Tt},data and mc don't match in some bins

possible bugs.....

- y1_pt<y2_pt in some events ,986/16144
- y1_pt:HGamPhotonsAuxDyn.pt[0]
- y2_pt:HGamPhotonsAuxDyn.pt[1]
- photonHandler->getCorrectedContainer()
- shallowContainer.sort(comparePt);
- could anyone do crosscheck?



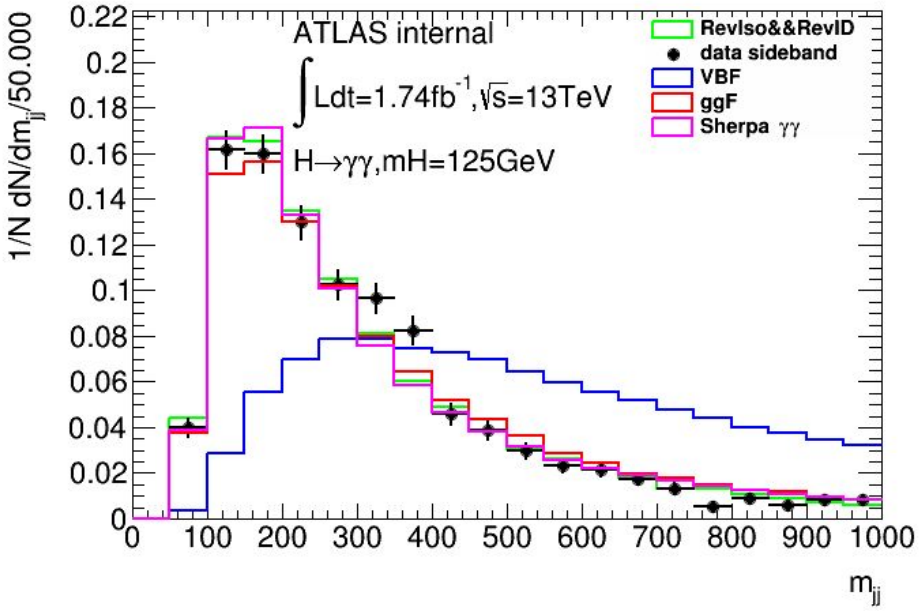


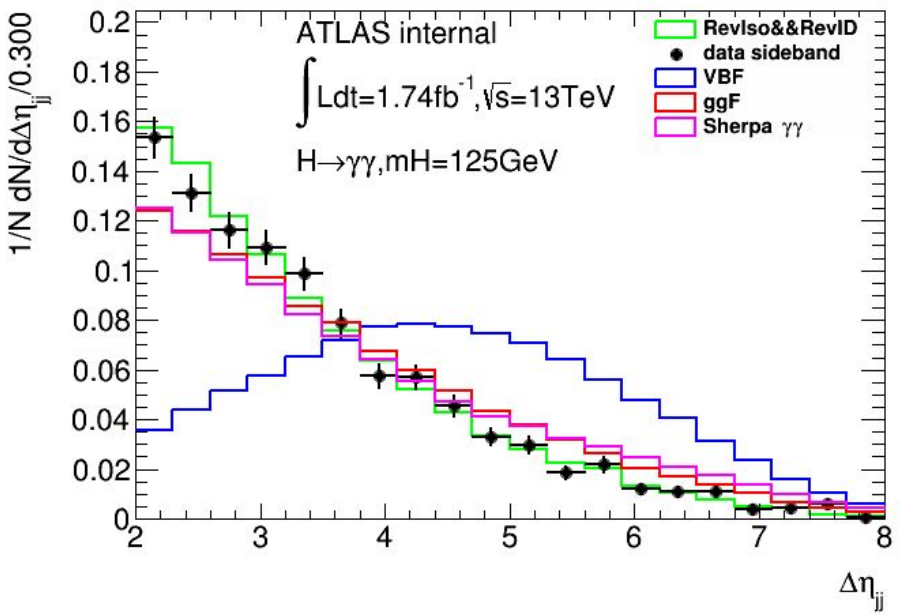
to do list

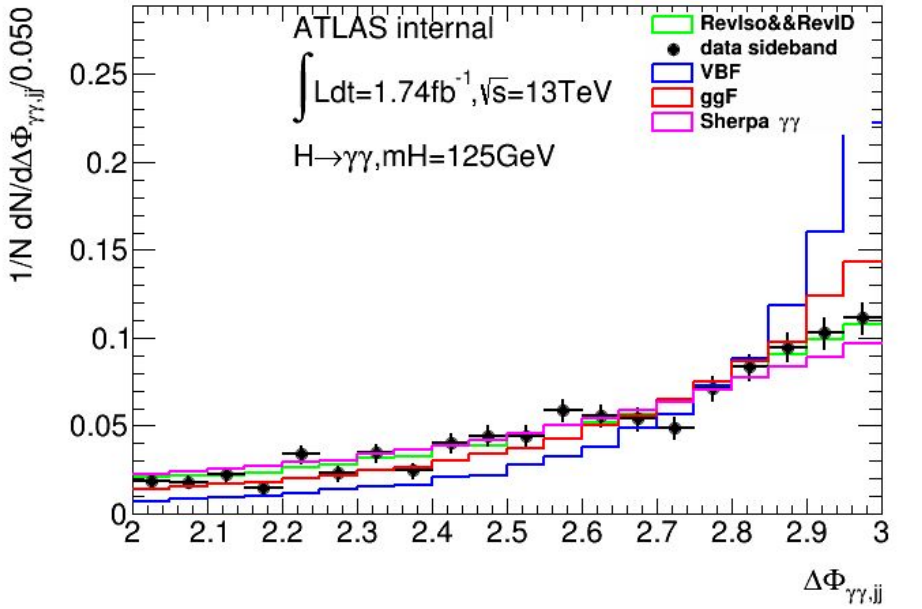
- check new variables

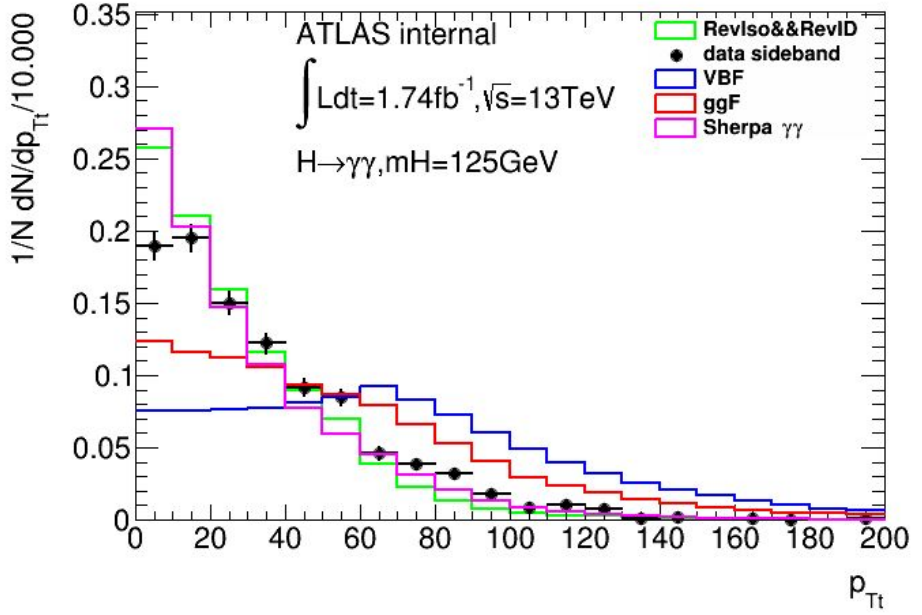
- loop MVA configuration and variable combination

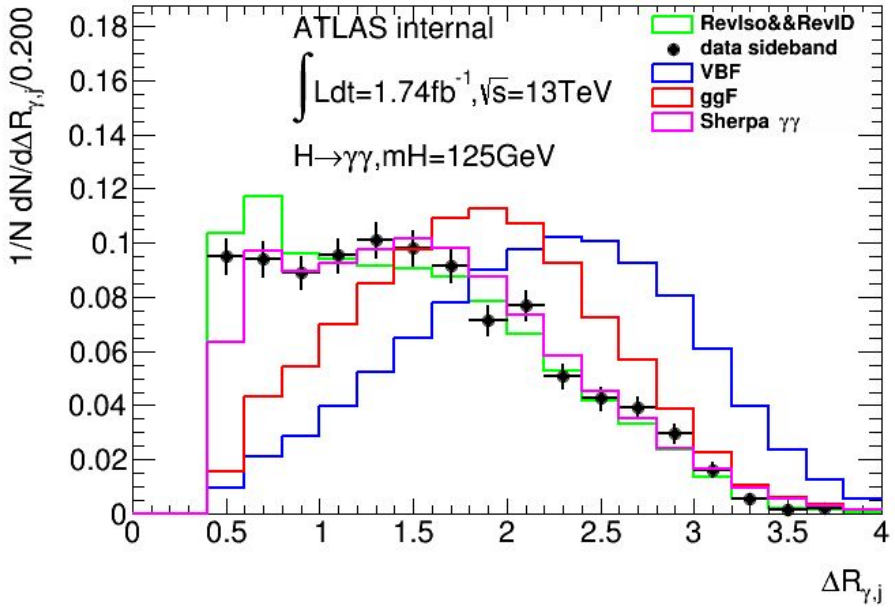
back up

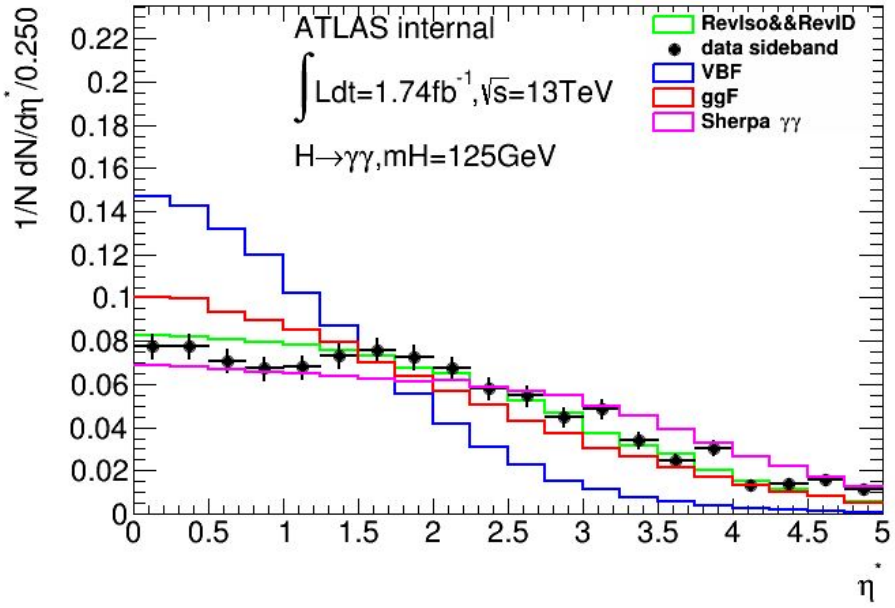

ATLAS internal
∫Ldt=1.74fb-1,√s=13TeV
H→γγ,mH=125GeV
RevIso&&RevID
data sideband
VBF
ggF
Sherpa γγ
1/N dN/dmjj/50.000
mjj


ATLAS internal
∫Ldt=1.74fb-1,√s=13TeV
H→γγ,mH=125GeV
RevIso&&RevID
data sideband
VBF
ggF
Sherpa γγ
1/N dN/dΔηjj/0.300
Δηjj


ATLAS internal
∫Ldt=1.74fb-1,√s=13TeV
H→γγ,mH=125GeV
RevIso&&RevID
data sideband
VBF
ggF
Sherpa γγ
1/N dN/dΔΦγγ,jj/0.050
ΔΦγγ,jj


ATLAS internal
∫Ldt=1.74fb-1,√s=13TeV
H→γγ,mH=125GeV
RevIso&&RevID
data sideband
VBF
ggF
Sherpa γγ
1/N dN/dpTt/10.000
pTt


ATLAS internal
∫Ldt=1.74fb-1,√s=13TeV
H→γγ,mH=125GeV
RevIso&&RevID
data sideband
VBF
ggF
Sherpa γγ
1/N dN/dΔRγ,j/0.200
ΔRγ,j


ATLAS internal
∫Ldt=1.74fb-1,√s=13TeV
H→γγ,mH=125GeV
RevIso&&RevID
data sideband
VBF
ggF
Sherpa γγ
1/N dN/dη*/0.250
η*

2x2D sideband method

red: leading p_T photon candidate

blue: sub-leading p_T photon candidate

A: *Tight and Isolated (TI)*

B: *Tight and not Isolated (TN)*

C: *not Tight and Isolated (nTI)*

D: *not Tight and not Isolated (nTN)*

region	enriched with
DD	jet-jet
DA	γ-jet
AD	jet-γ
AA	γγ

- ***truncate information into the 7 shaded regions by assuming:***
  - fake rates in γ-jet and jet-jet events are equal
  - neglect possible jet-jet or photon-photon correlations