Weekly Report

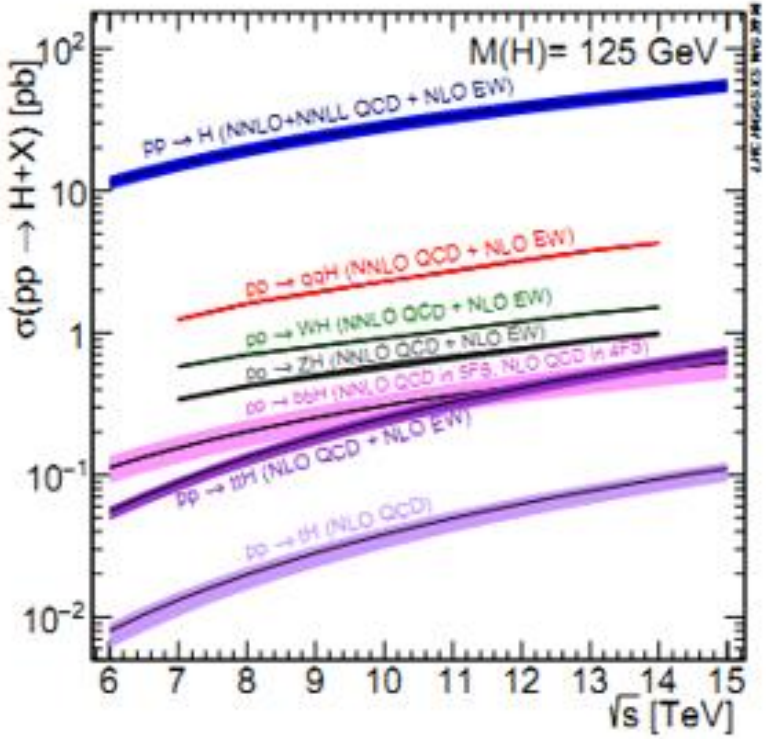
Fangyi Guo

2017.7.9

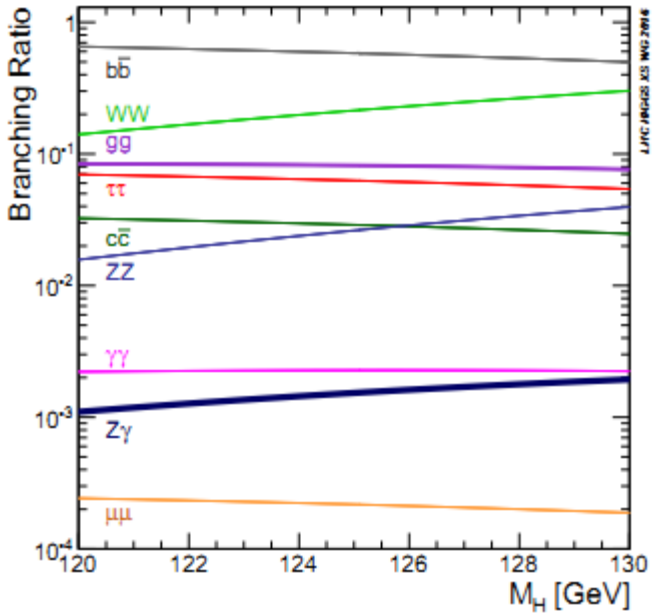
Product cross section

- $gg\mathrm{H}: 49.7^{+11\%}_{-11\%}$
- $\mathrm{VBF}: 4.28^{+2\%}_{-2\%}$
- $\mathrm{WH}: 1.51^{+2\%}_{-2\%}$
- $ZH: 0.99^{+5\%}_{-5\%}$
- $t\bar{t}H: 0.61^{+9\%}_{-13\%}$
- Total: 57.1pb

- Data from PDG



Decay branch ratio



Decay Channel	Mass resolution	
$\mathbf{H \to \gamma\gamma}$	1-2%	Excellent mass resolution
$\mathbf{H \to ZZ \to 4l}$	1-2%	Low branching ratio
$\mathbf{H \to W^+W^-}$ $\mathbf{\to l\nu l'\nu'}$	20%	Large branch fraction but poor resolution due to neutrinos
$\mathbf{H \to b\bar{b}}$	10%	Large background and poor mass resolution
$\mathbf{H \to \tau^+\tau^-}$	15%	

Sample

- 13TeV:
  - VBF sample
  - ggH sample
  - Sherpa 3jet sample as diphoton background
  - Data

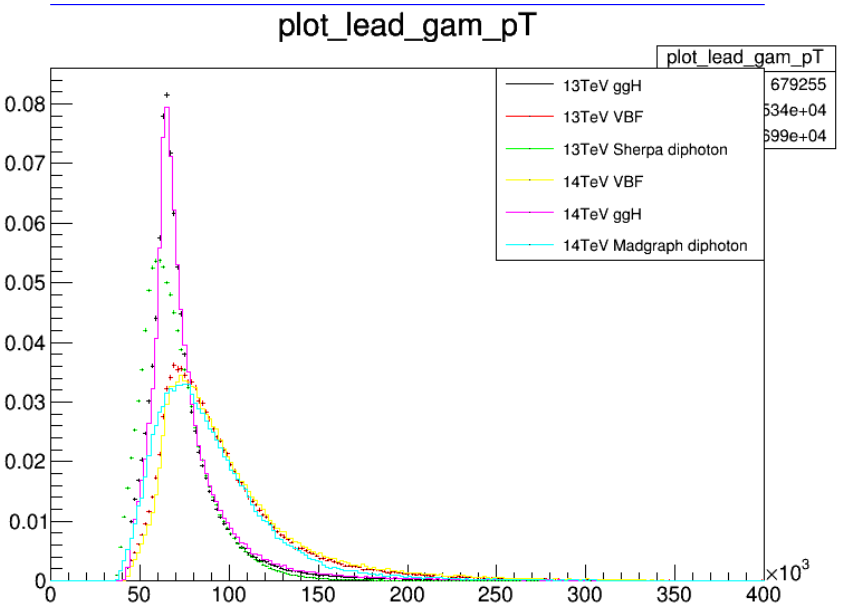
- 14TeV
  - VBF sample
  - ggH sample
  - Madgraph sample as background

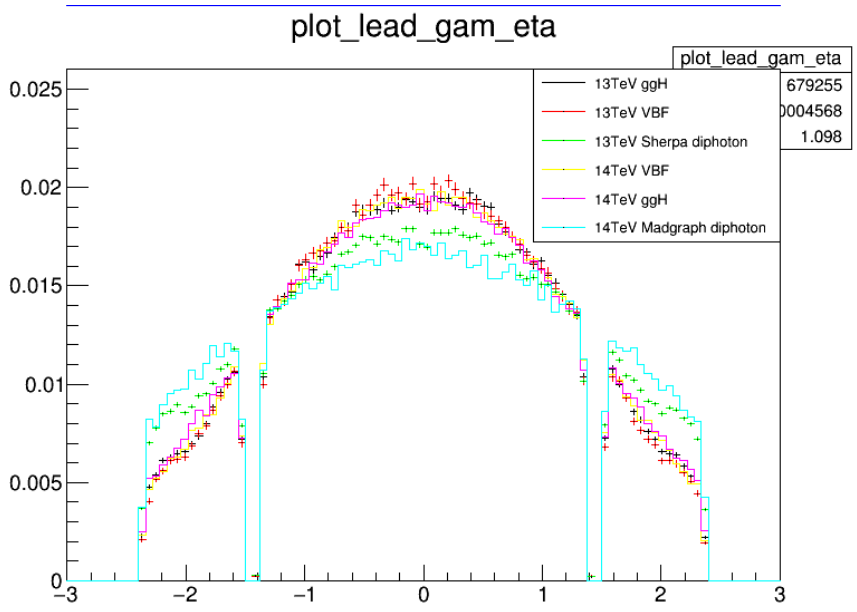
Some relevant variables

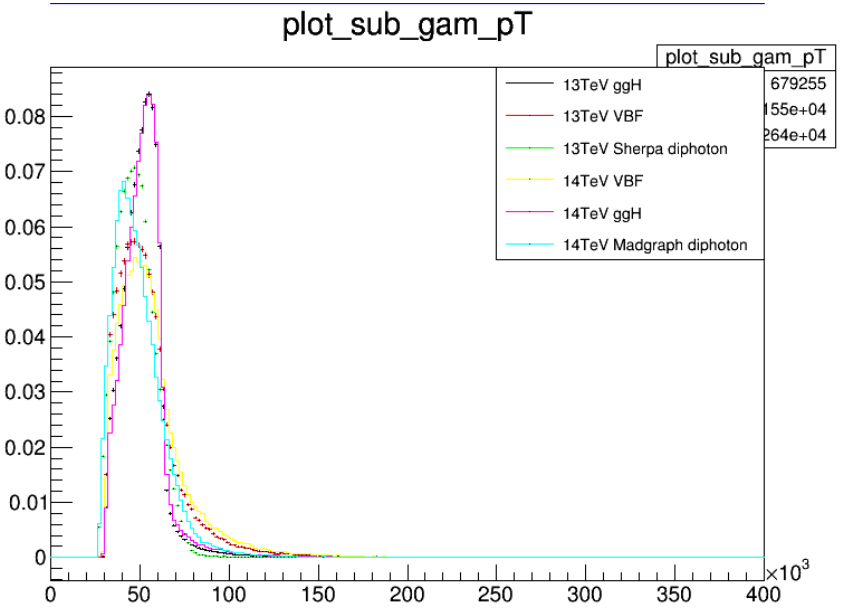
- Leading photon/jet pT &eta
- Subleading photon/jet pT&eta
- Diphoton pT&invariant mass
- Number of jets
- 6 VBF-sensitive variables (next page)

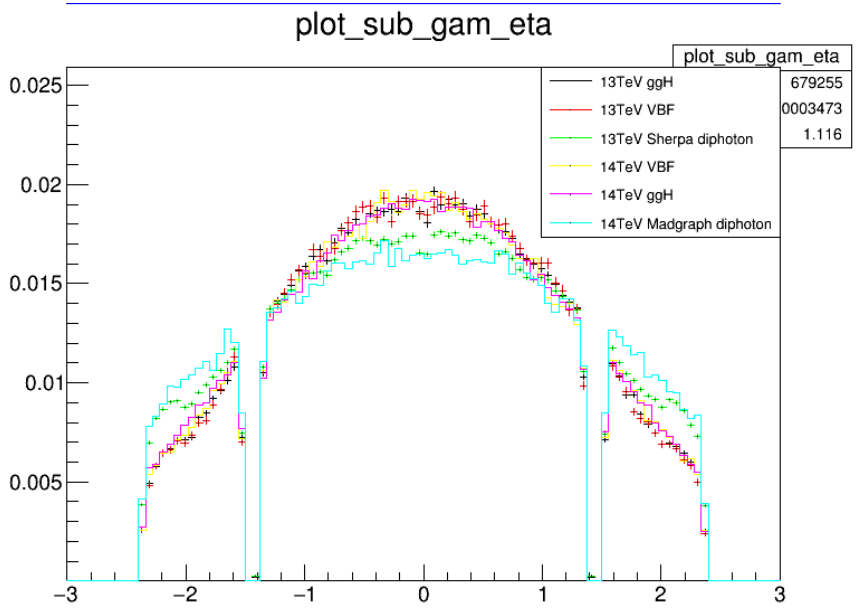
Description of some relevant variables

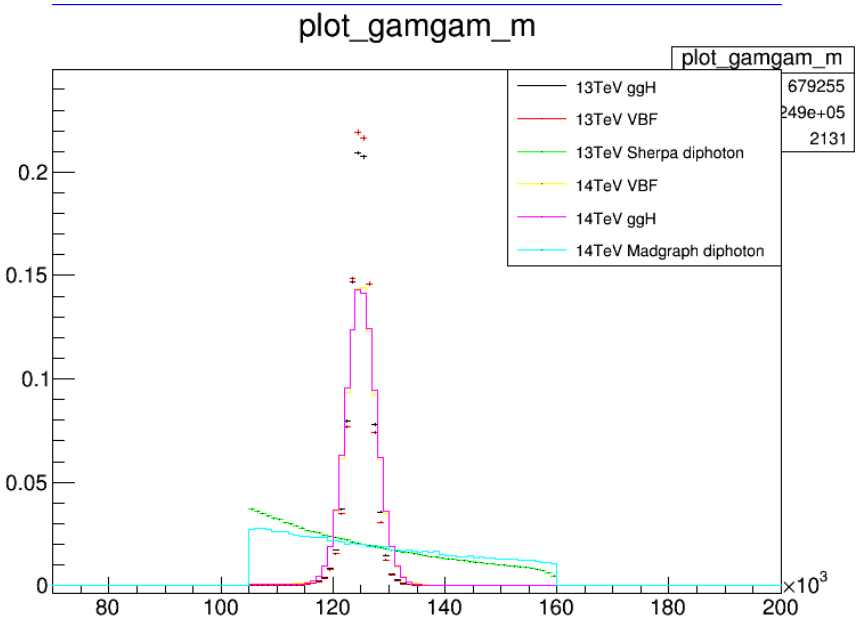
Variable	Description	C++ calculation
m_{jj}	Dijet mass: invariant mass of leading and subleading jets	`(j1+j2).M()`
$\Delta\eta_{jj}$	Pseudorapidity separation between the leading two jets	`fabs(j1.Eta()-j2.Eta())`
η_{jet1}	Pseudorapidity of the leading jet	`j1.Eta()`
η_{jet2}	Pseudorapidity of the subleading jet	`j2.Eta()`
p_{Tt}	Diphoton p_T projected perpendicular to the diphoton thrust axis	`fabs(g1.Px()*g2.Py()-g2.Px()*g1.Py())/(g1-g2).Pt()*2`
$\Delta\phi_{\gamma\gamma,jj}$	Azimuthal angle between the diphoton and dijet systems	`fabs((g1+g2).DeltaPhi(j1+j2))`
Δy_{jj}	Rapidity separation between the leading two jets	`fabs(j1.Rapidity()-j2.Rapidity())`
$p_{T\gamma\gamma jj}$	p_T of the $\gamma\gamma$jj system	`(g1+g2+j1+j2).Pt()`
$\Delta p_{T\gamma\gamma}$	p_T difference between the the two photons	`fabs(g1.Pt()-g2.Pt())`
$\eta^{Zepp}_{\gamma\gamma}$	Zeppenfeld variable for diphoton pseudorapidity, or $\eta_{\gamma\gamma} - \langle\eta_{jj}\rangle$	`(g1+g2).Eta() - ((j1.Eta() + j2.Eta())/2)`
$\min(\Delta R_{j\gamma})$	Minimum ΔR between either leading/subleading jet and leading/subleading photon	-

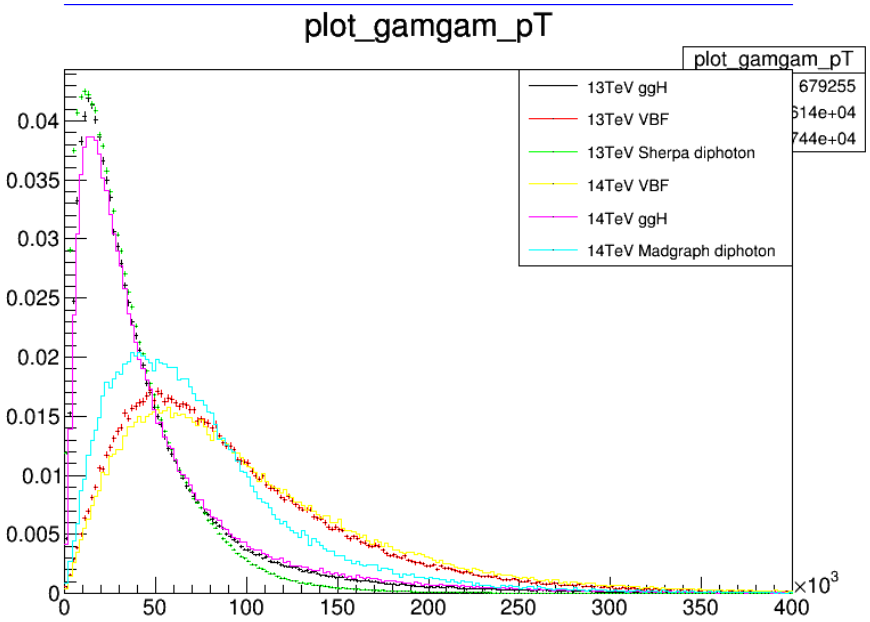

plot_lead_gam_pT
plot_lead_gam_pT
679255
534e+04
599e+04
13TeV ggH
13TeV VBF
13TeV Sherpa diphoton
14TeV VBF
14TeV ggH
14TeV Madgraph diphoton
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
0
50
100
150
200
250
300
350
400
×10^3

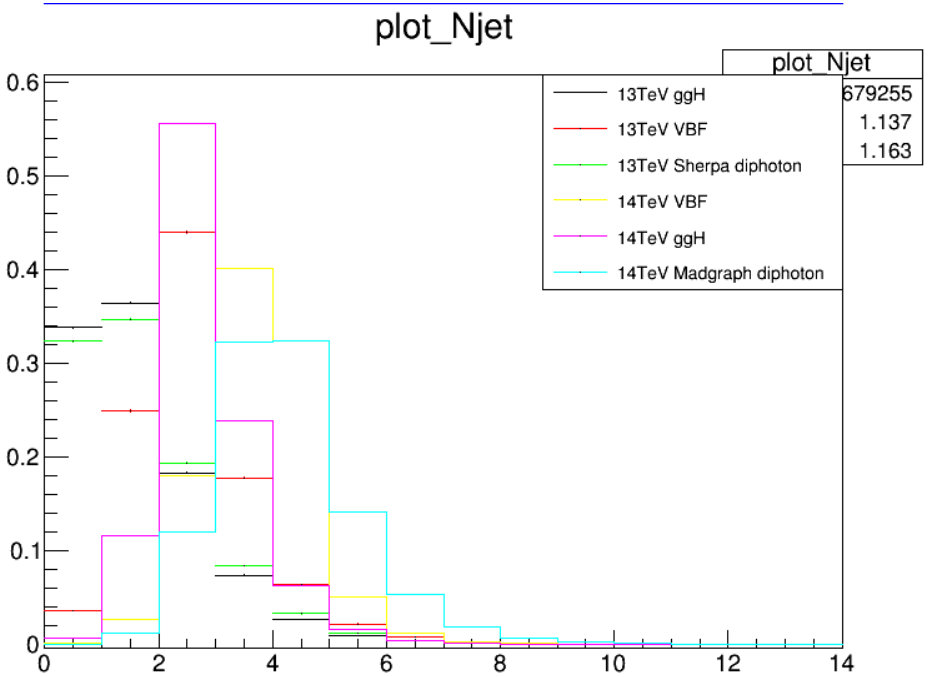

plot_lead_gam_eta
plot_lead_gam_eta
679255
0004568
1.098
13TeV ggH
13TeV VBF
13TeV Sherpa diphoton
14TeV VBF
14TeV ggH
14TeV Madgraph diphoton
0.025
0.02
0.015
0.01
0.005
0
−3
−2
−1
0
1
2
3

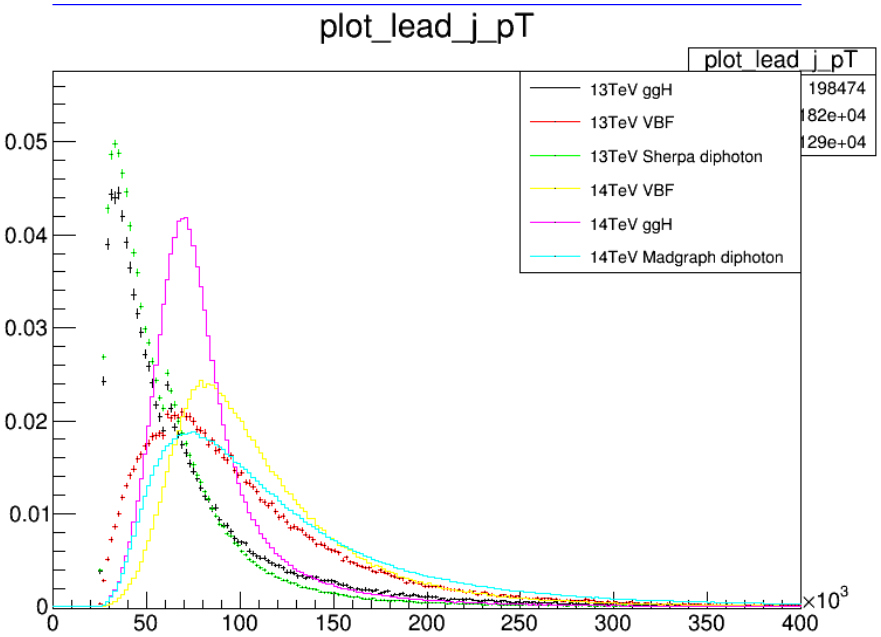

plot_sub_gam_pT
plot_sub_gam_pT
679255
155e+04
264e+04
13TeV ggH
13TeV VBF
13TeV Sherpa diphoton
14TeV VBF
14TeV ggH
14TeV Madgraph diphoton
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
0
50
100
150
200
250
300
350
400
×10^3

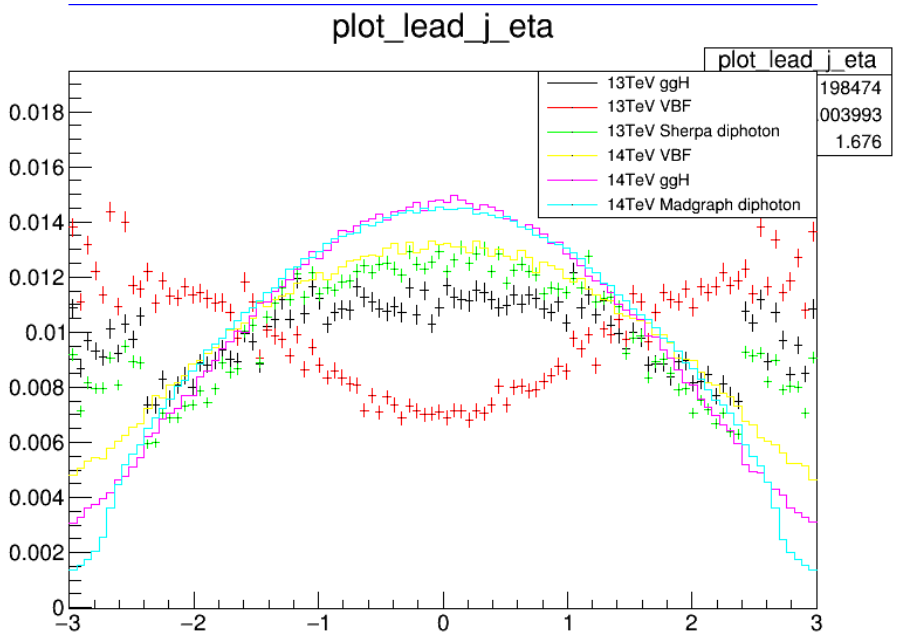

plot_sub_gam_eta
plot_sub_gam_eta
679255
0003473
1.116
13TeV ggH
13TeV VBF
13TeV Sherpa diphoton
14TeV VBF
14TeV ggH
14TeV Madgraph diphoton
0.025
0.02
0.015
0.01
0.005
−3
−2
−1
0
1
2
3

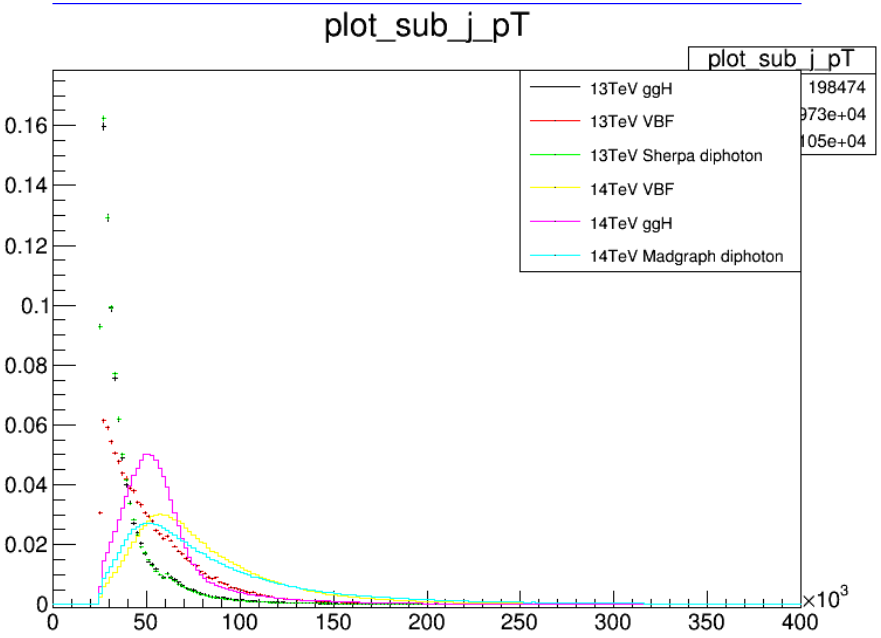

plot_gamgam_m
plot_gamgam_m
679255
249e+05
2131
13TeV ggH
13TeV VBF
13TeV Sherpa diphoton
14TeV VBF
14TeV ggH
14TeV Madgraph diphoton
0.2
0.15
0.1
0.05
0
80
100
120
140
160
180
200
×10^3

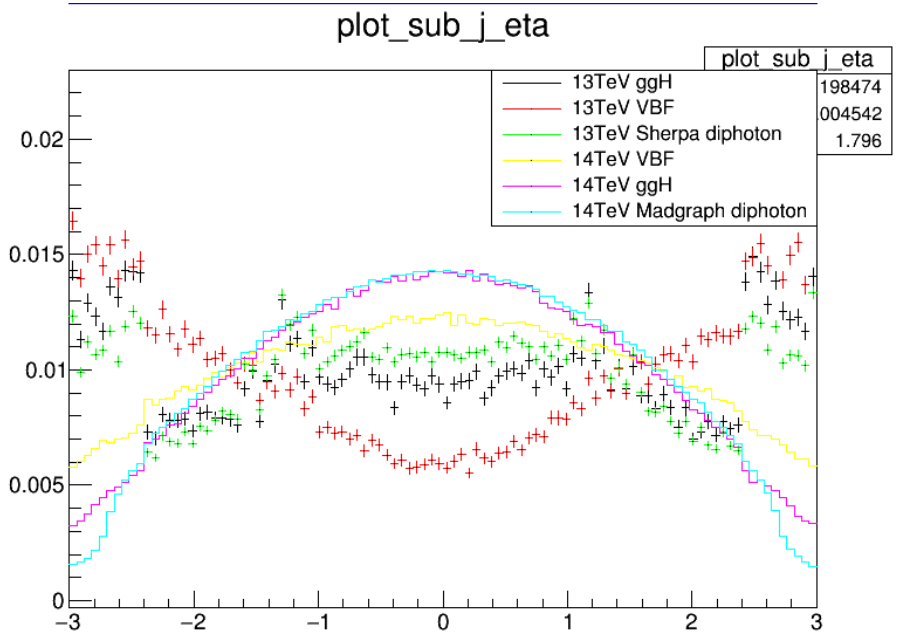

plot_gamgam_pT
plot_gamgam_pT
679255
13TeV ggH
13TeV VBF
13TeV Sherpa diphoton
14TeV VBF
14TeV ggH
14TeV Madgraph diphoton
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
0
50
100
150
200
250
300
350
400
×10^3

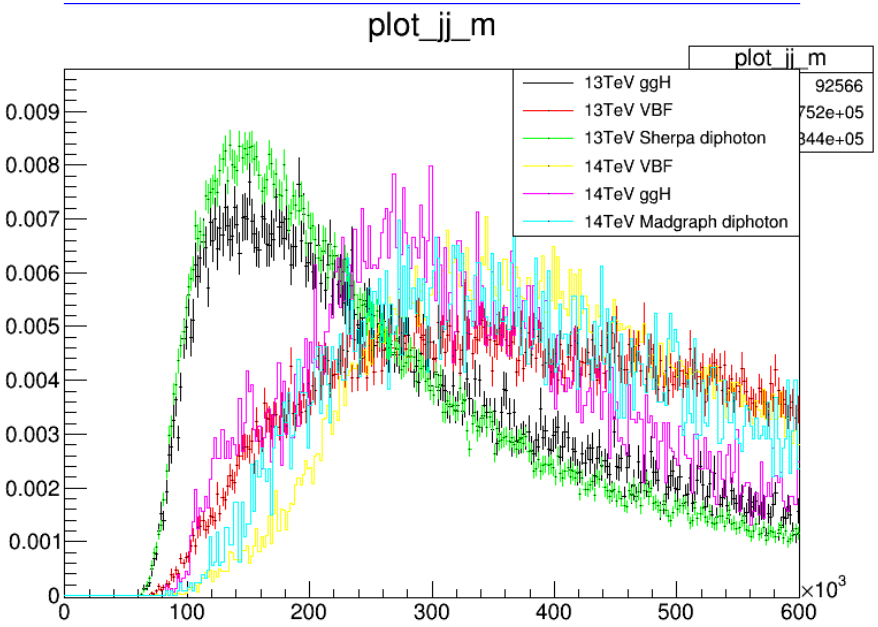

plot_Njet
plot_Njet
679255
1.137
1.163
13TeV ggH
13TeV VBF
13TeV Sherpa diphoton
14TeV VBF
14TeV ggH
14TeV Madgraph diphoton
0.6
0.5
0.4
0.3
0.2
0.1
0
0
2
4
6
8
10
12
14

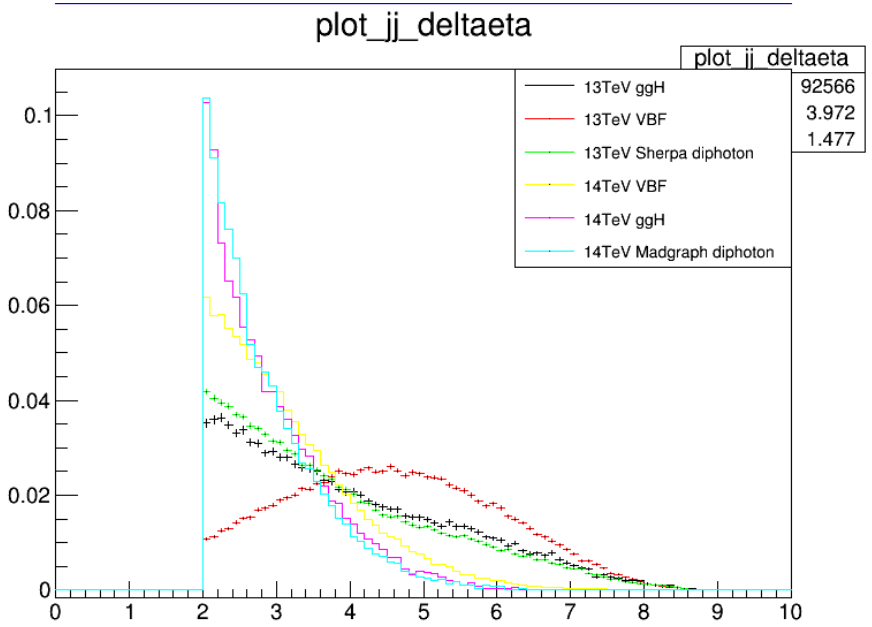

plot_lead_j_pT
plot_lead_j_pT
198474
182e+04
129e+04
13TeV ggH
13TeV VBF
13TeV Sherpa diphoton
14TeV VBF
14TeV ggH
14TeV Madgraph diphoton
0.05
0.04
0.03
0.02
0.01
0
0
50
100
150
200
250
300
350
400
×10^3

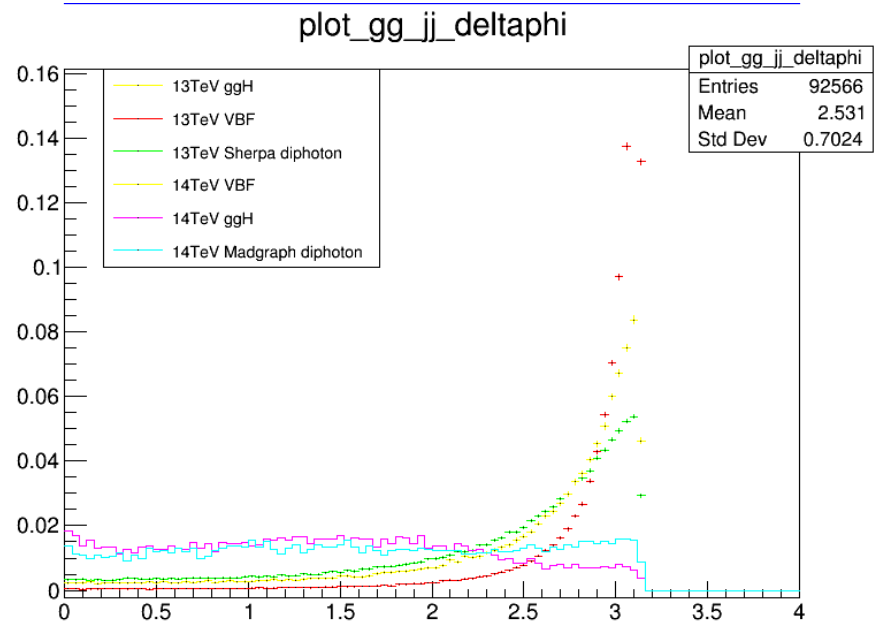

plot_lead_j_eta
plot_lead_j_eta
198474
003993
1.676
13TeV ggH
13TeV VBF
13TeV Sherpa diphoton
14TeV VBF
14TeV ggH
14TeV Madgraph diphoton
0.018
0.016
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
−3
−2
−1
0
1
2
3

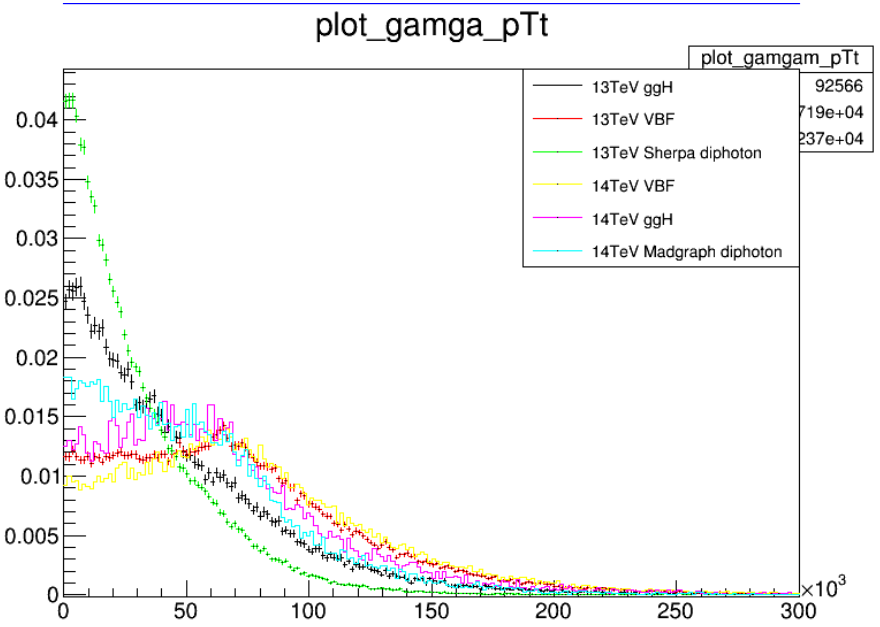

plot_sub_j_pT
plot_sub_j_pT
198474
973e+04
105e+04
13TeV ggH
13TeV VBF
13TeV Sherpa diphoton
14TeV VBF
14TeV ggH
14TeV Madgraph diphoton
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
0
50
100
150
200
250
300
350
400
×10^3

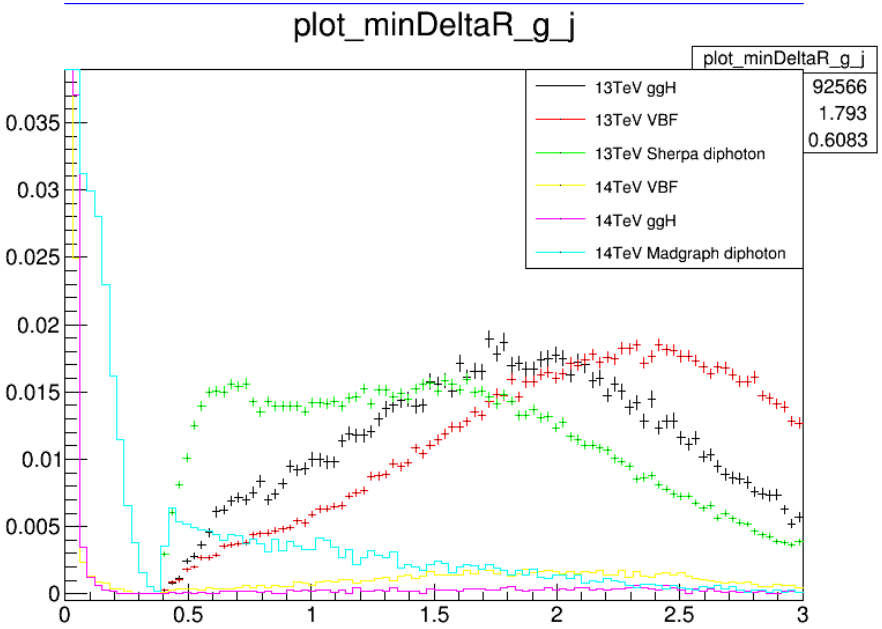

plot_sub_j_eta
plot_sub_j_eta
198474
004542
1.796
13TeV ggH
13TeV VBF
13TeV Sherpa diphoton
14TeV VBF
14TeV ggH
14TeV Madgraph diphoton
0.02
0.015
0.01
0.005
0
−3
−2
−1
0
1
2
3

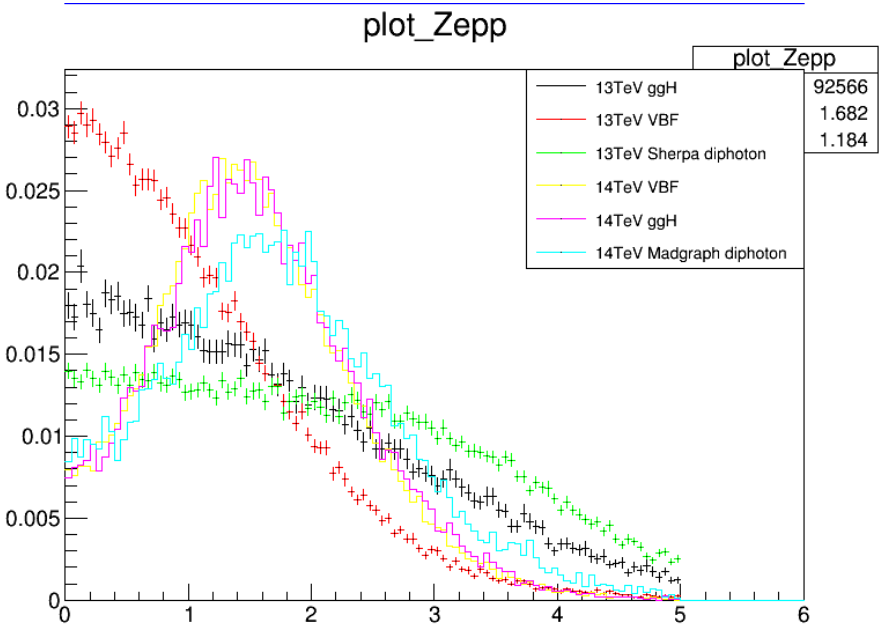

plot_jj_m
plot_jj_m
92566
752e+05
344e+05
13TeV ggH
13TeV VBF
13TeV Sherpa diphoton
14TeV VBF
14TeV ggH
14TeV Madgraph diphoton
0.009
0.008
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0
0
100
200
300
400
500
600
×10^3


plot_jj_deltaeta
plot_jj_deltaeta
92566
3.972
1.477
13TeV ggH
13TeV VBF
13TeV Sherpa diphoton
14TeV VBF
14TeV ggH
14TeV Madgraph diphoton
0.1
0.08
0.06
0.04
0.02
0
0
1
2
3
4
5
6
7
8
9
10


plot_gg_jj_deltaphi
plot_gg_jj_deltaphi
Entries 92566
Mean 2.531
Std Dev 0.7024
13TeV ggH
13TeV VBF
13TeV Sherpa diphoton
14TeV VBF
14TeV ggH
14TeV Madgraph diphoton
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
0
0.5
1
1.5
2
2.5
3
3.5
4


plot_gamga_pTt
plot_gamgam_pTt
92566
719e+04
237e+04
13TeV ggH
13TeV VBF
13TeV Sherpa diphoton
14TeV VBF
14TeV ggH
14TeV Madgraph diphoton
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
0
50
100
150
200
250
300
×10^3


plot_minDeltaR_g_j
plot_minDeltaR_g_j
92566
1.793
0.6083
13TeV ggH
13TeV VBF
13TeV Sherpa diphoton
14TeV VBF
14TeV ggH
14TeV Madgraph diphoton
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
0.5
1
1.5
2
2.5
3


plot_Zepp
plot_Zepp
92566
1.682
1.184
13TeV ggH
13TeV VBF
13TeV Sherpa diphoton
14TeV VBF
14TeV ggH
14TeV Madgraph diphoton
0.03
0.025
0.02
0.015
0.01
0.005
0
1
2
3
4
5
6

Remaining problem

- Not include 13TeV data
- Something wrong with 14TeV VBF
- Seems lack of some procedure

Further work

- Solve above problems
- Do some BDT test with 14TeV sample
- Read 13TeV analysis note and have some comprehension about the whole procedure