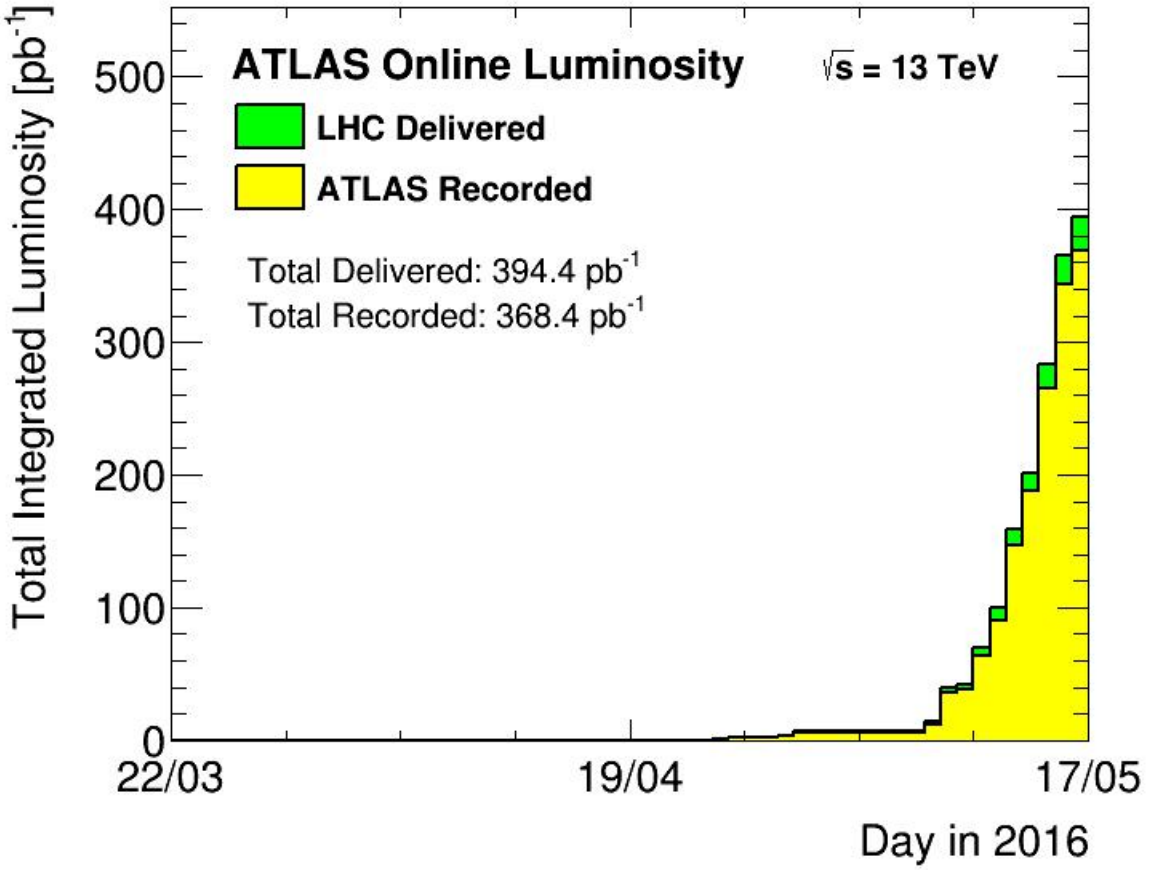
weekly report



~4pb^{-1} in first GRL

Yu Zhang

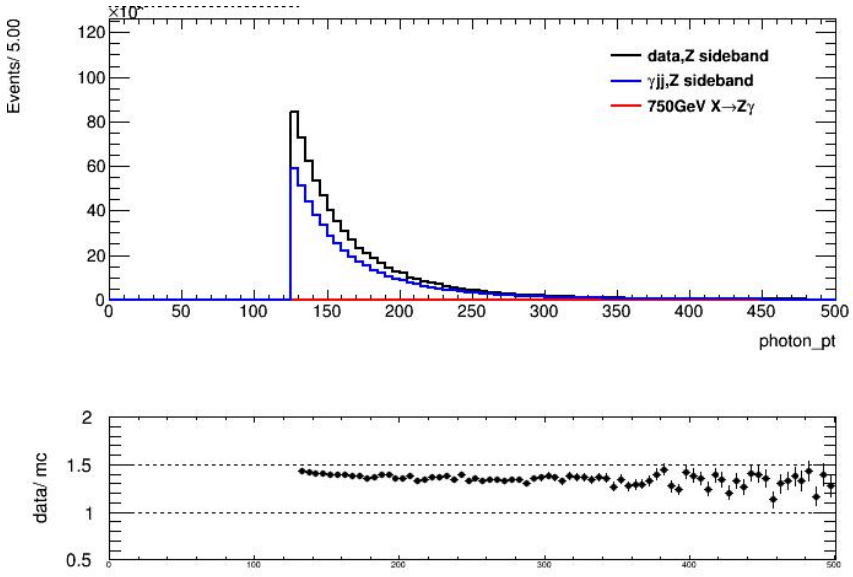
05.16

outline

- resolved Z(qq)γ
- categorization on high-mass diphoton

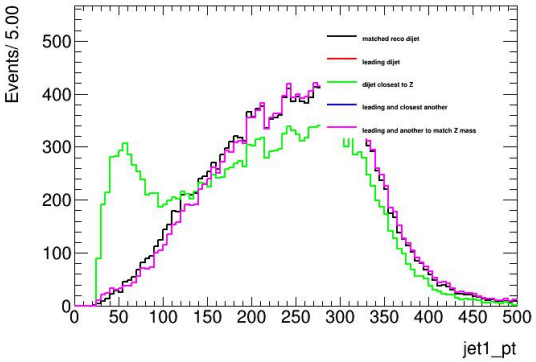
Introduction

- Selection(preliminary, not decided)
  - GRL,DQ,PV, trigger:HLT_g120_loose
  - Photon:
    - pT>125GeV, |eta|<2.37,remove crack region
    - Author, OQ, Ambiguity, Tight ID
    - Isolation: FixedCutCaloOnly, topoetcone40<0.022*Et+2.45GeV
  - Jet:
    - pT>25GeV, |eta|<4.4, JVT>0.64, jet cleaning
    - Overlap Removal
  - Overlap removal with boost analysis
- Normalizetion
  - scale factor ~1.4 is used on mc

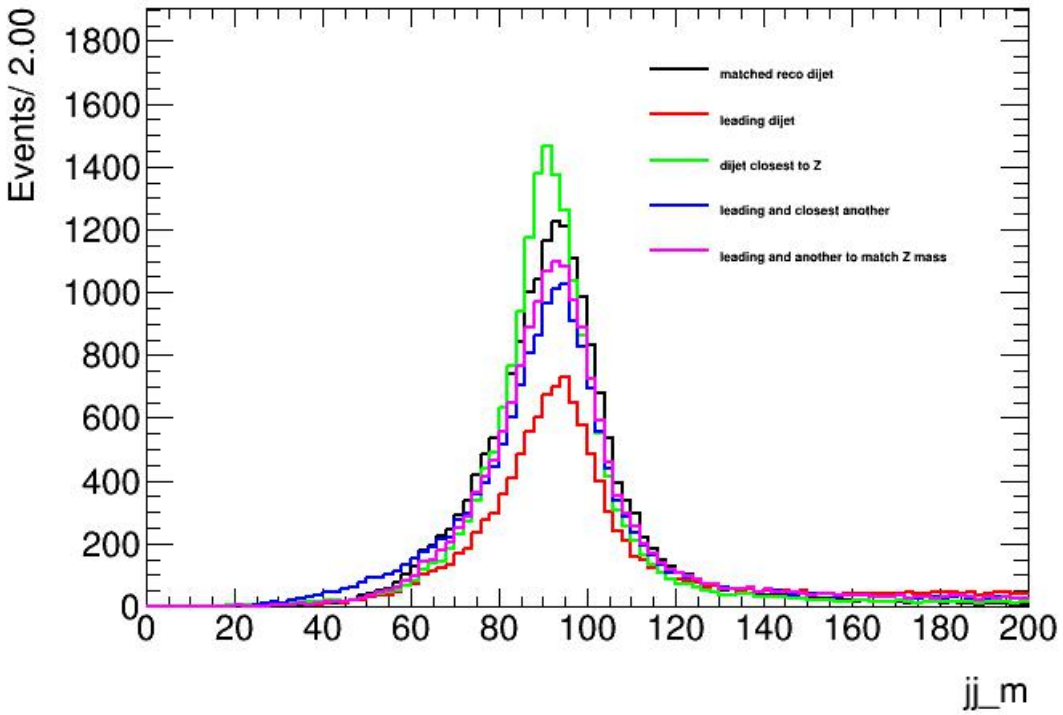


dijet combination

- four strategy
  - ①leading dijet
  - ②dijet closest to Z mass
  - ③leading and another closest jet
  - ④leading and another jet to reconstruct best M_Z
- use ④ finally. rate of correct match with truth in table



	match j1	match j2	match dijet
①	86.9%	40.3%	39.0%
②	71.9%	53.4%	49.7%
③	86.9%	57.1%	55.1%
④	86.9%	58.4%	55.8%



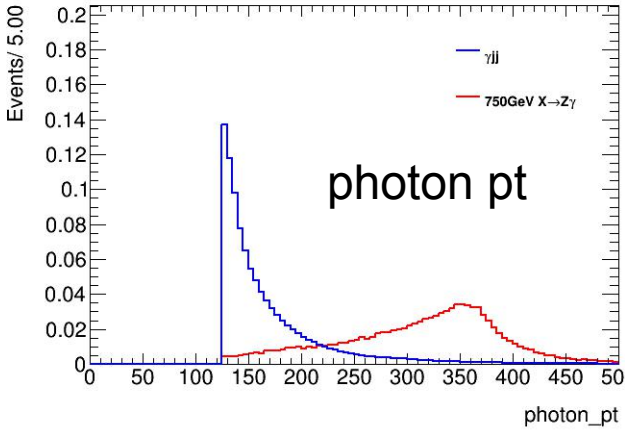
$$< S^2 >= \frac{1}{2}\int \frac{(\hat{y}_s(y) - \hat{y}_b(y))^2}{\hat{y}_s(y) + \hat{y}_b(y)} dy$$

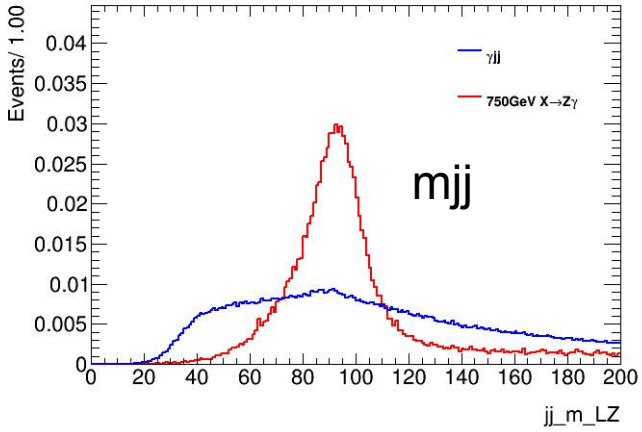
optimization

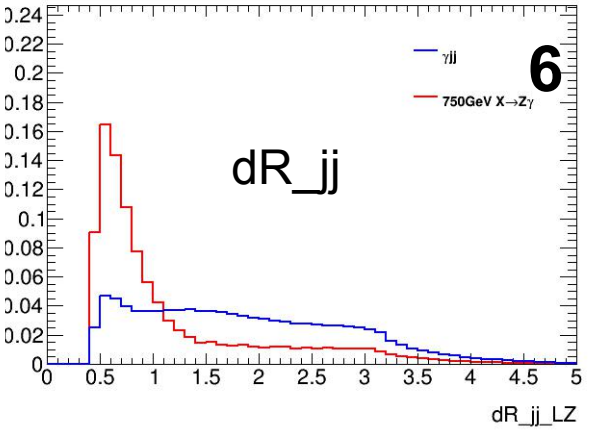
- separation power and correlation of candidate variables
  - can get them easily from TMVA, but failed due to memory issue

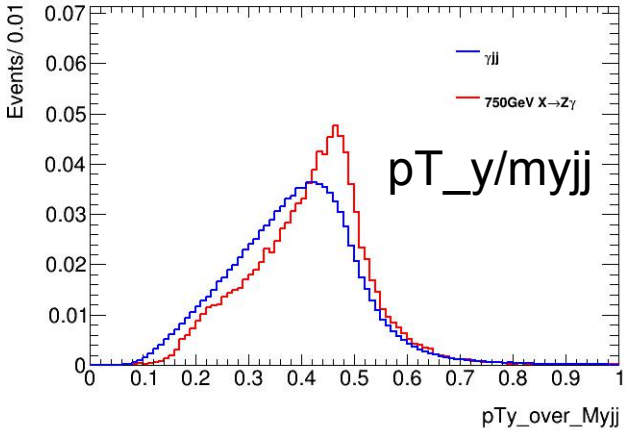
variables	separation power
M_yj1	0.637
M_yjj	0.625
photon_pt	0.597
HT_yj2	0.578
HT_yjj	0.564
HT_yj1	0.556
dPt_y_j2	0.519
jj_pt	0.492
pT_yj2	0.455
jet1_pt	0.375
dPt_jj	0.263
dR_jj	0.190

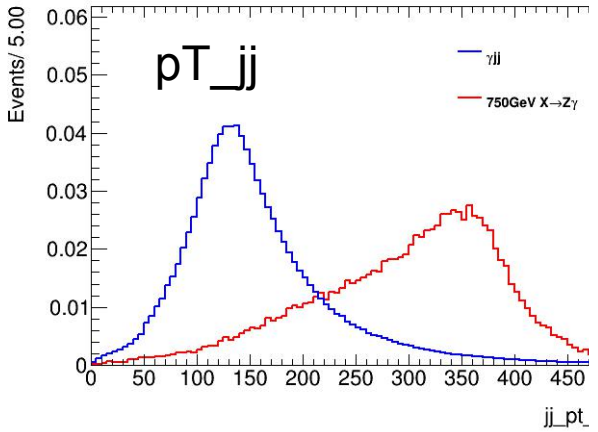
- discussion
  - M_yj1 correlated to Myjj
  - many variables correlated to photon pt
  - corr in signal : jj_pt 0.488 jet1_pt 0.379
  - photon pt is powerful than relative pt
  - dR_jj is not powerful
  - definitely, mjj will be used
  - first use photon_pt and mjj to optimize

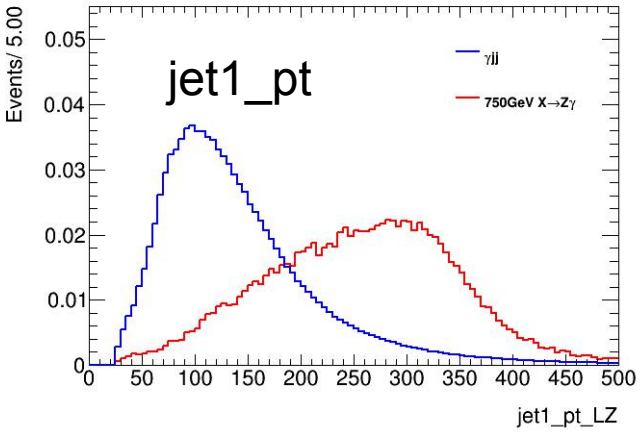

photon pt
γjj
750GeV X→Zγ
Events/ 5.00
photon_pt

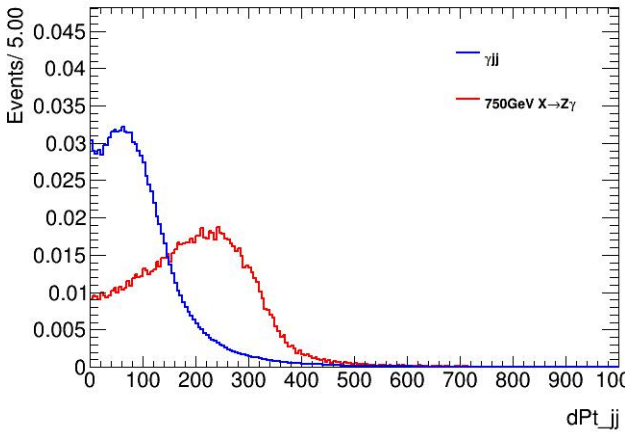

mjj
γjj
750GeV X→Zγ
Events/ 1.00
jj_m_LZ

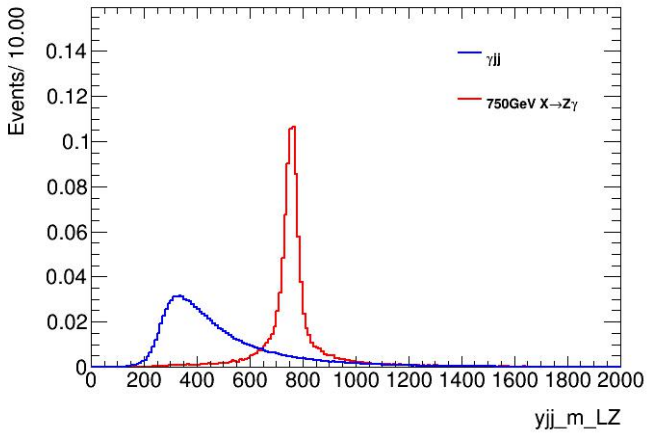

dR_jj
6
γjj
750GeV X→Zγ
dR_jj_LZ


pT_y/myjj
γjj
750GeV X→Zγ
Events/ 0.01
pTy_over_Myjj


pT_jj
γjj
750GeV X→Zγ
Events/ 5.00
jj_pt_

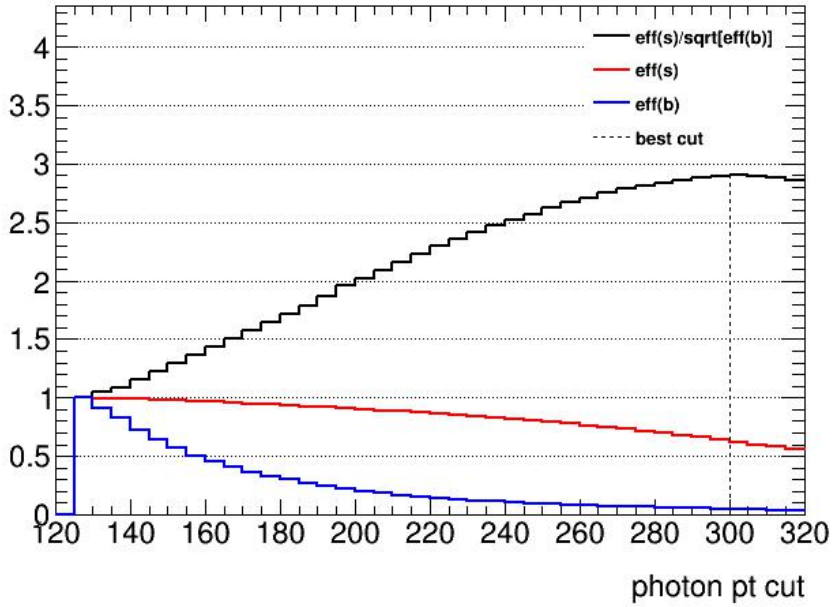

jet1_pt
γjj
750GeV X→Zγ
Events/ 5.00
jet1_pt_LZ

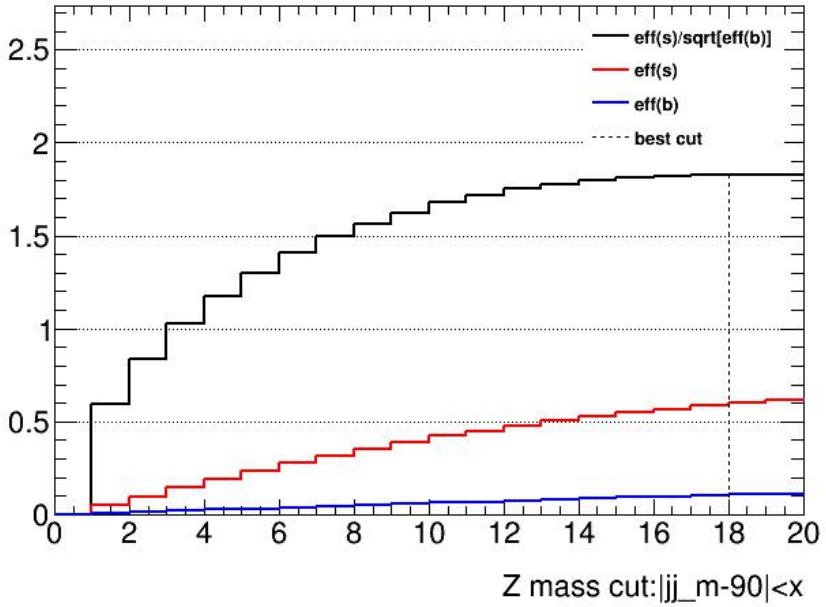

γjj
750GeV X→Zγ
Events/ 5.00
dPt_jj


γjj
750GeV X→Zγ
Events/ 10.00
yjj_m_LZ

optimization

- strategy
  - significance improvement : eff(s)/sqrt[eff(b)], since no assumption on signal cross section
  - first scan photon pt cut, then scan mjj cut
  - working point : photon pt > 300 GeV, |Z mass-90| < 18 GeV



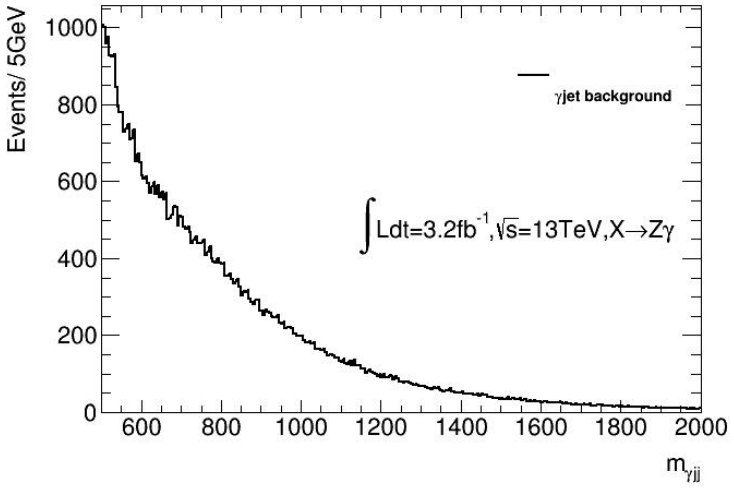


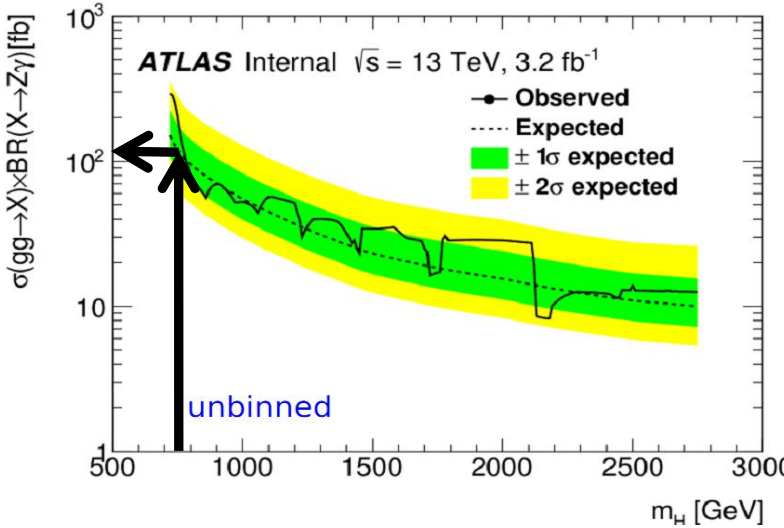
signal efficiency and upper limit

- rough etsimation on upper limit (plan to tight the selection)
  - sqrt(bkg yields)/eff(s)/lumi, bkg yields is number of events in [700,800]GeV, 9136 events, upper limit is 221 fb, worse than boost
    - 68% or 95%

	signal efficiency absolute (relative)
pre-selection and remove boost	0.539(0.539)
photon pt	0.335(0.622)
Z mass	0.206(0.613)
yjj mass in [700,800]	0.135(0.655)

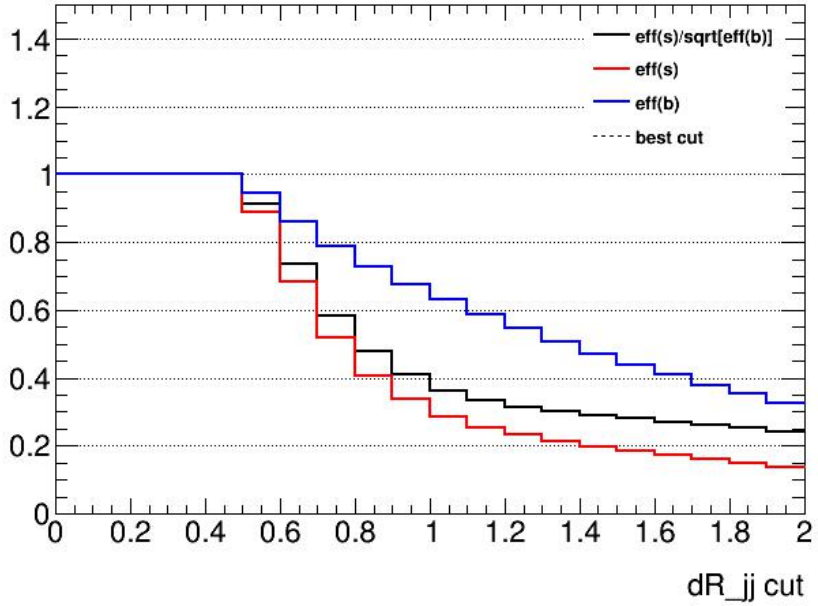
bad resolution

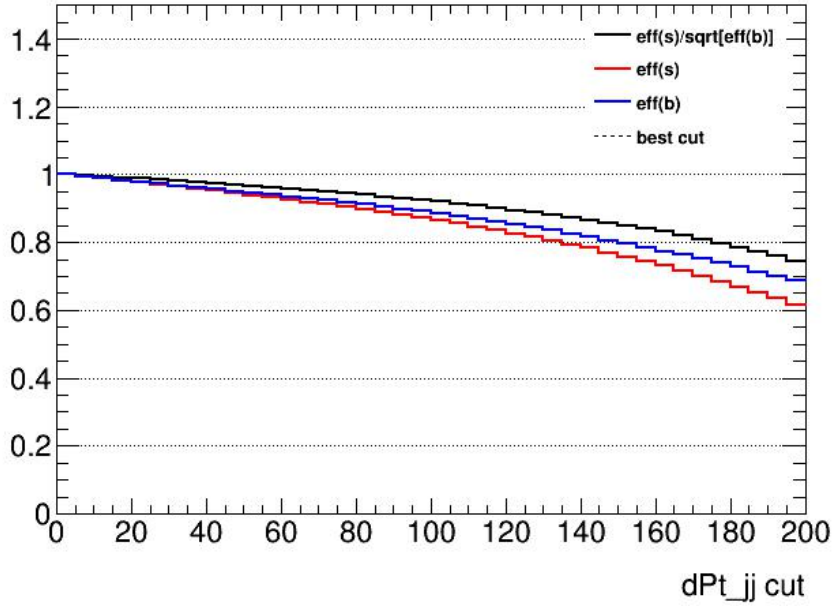




discussion

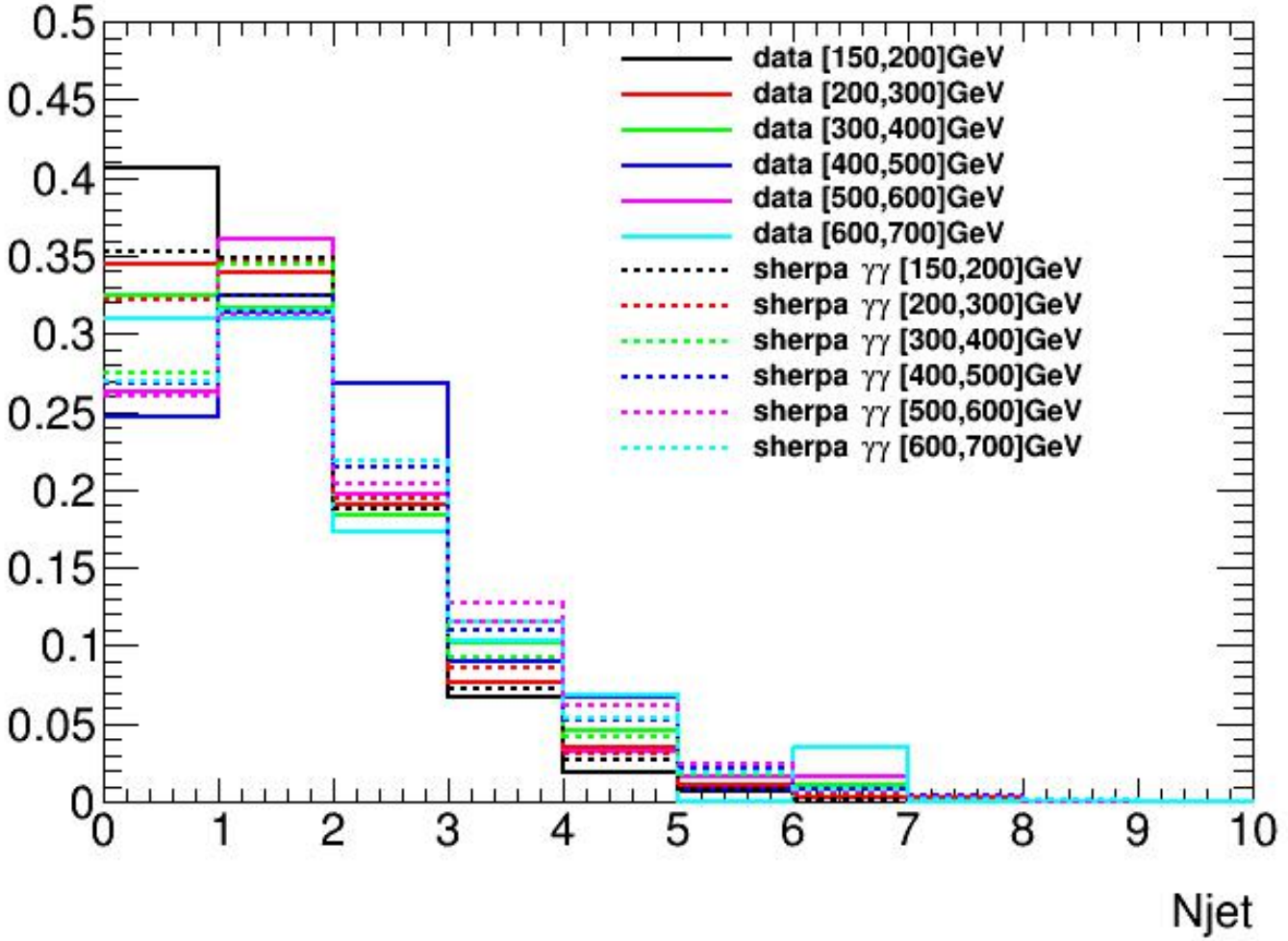
- dR_jj and dPt_jj seem to have low power after photon pt cut
- myjj has bad resolution
- plan to do a fit on m_yjj and obtain the resolution





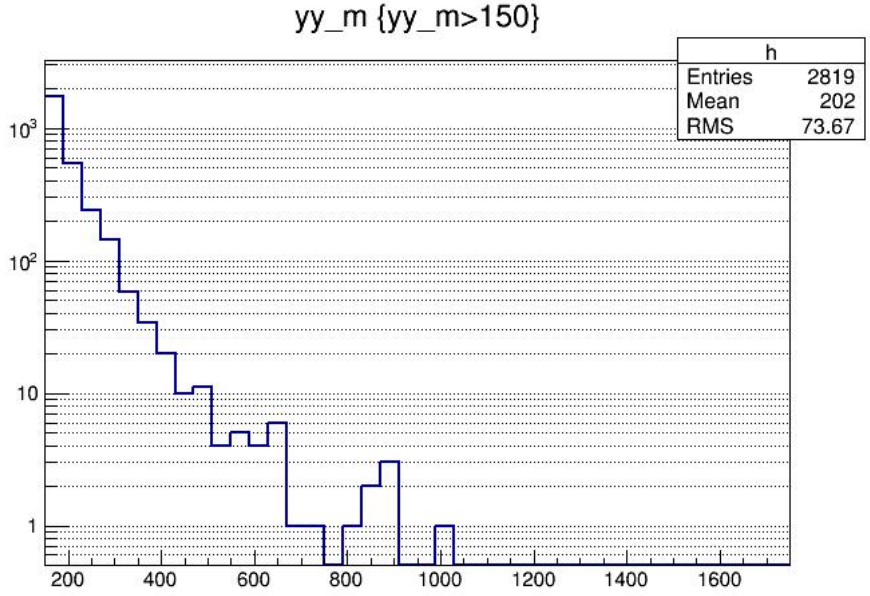
jet multiplicity

- data/mc comparison on jet multiplicity in different mass range

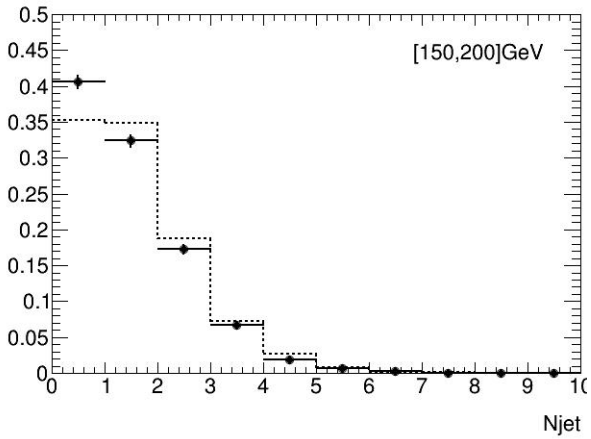


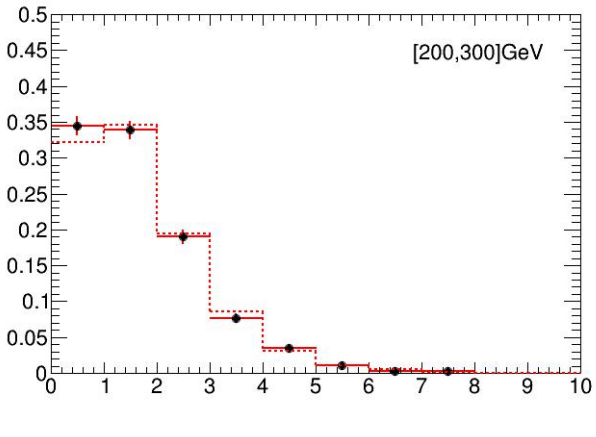
categorization on 750GeV diphoton

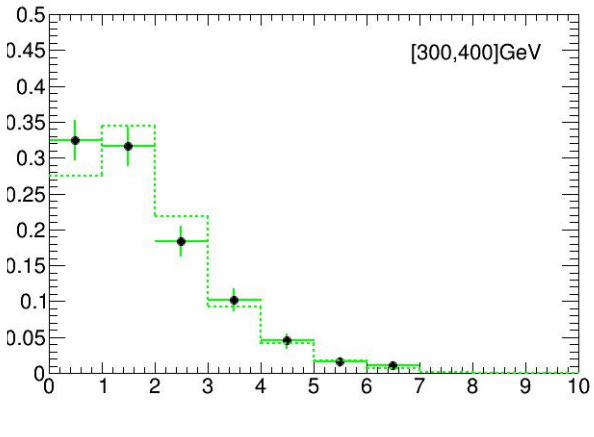
- two strategy
  - 0jet,1jet,>=2jet
  - BB(two photons in |eta|<0.75),nBB
- normalize
  - signal ggH750_W6p, scale to fitted signal yield
  - bkg: irreducible bkg from Sherpa DP (92.6%)
    : reducible bkg from RevID(fail ID, but pass other cut
- jet multiplicity reweight

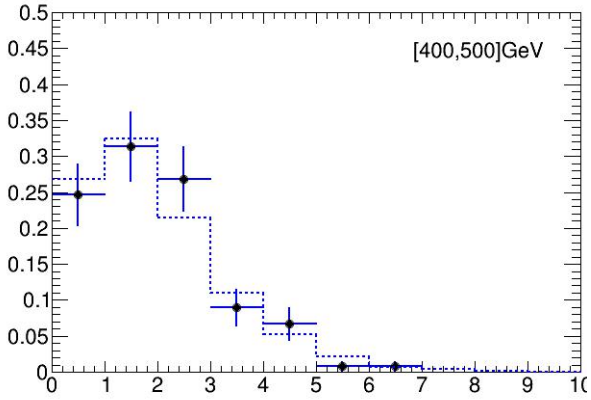


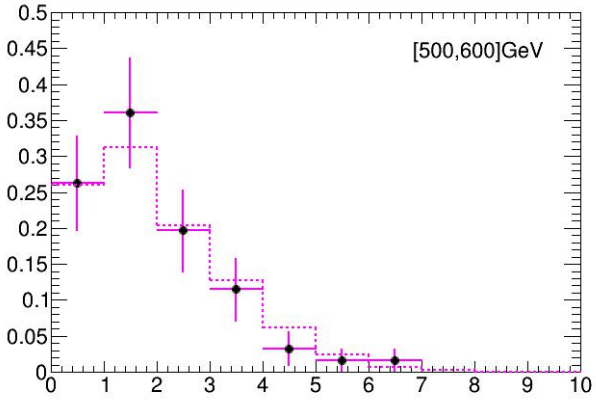
jet multiplicity

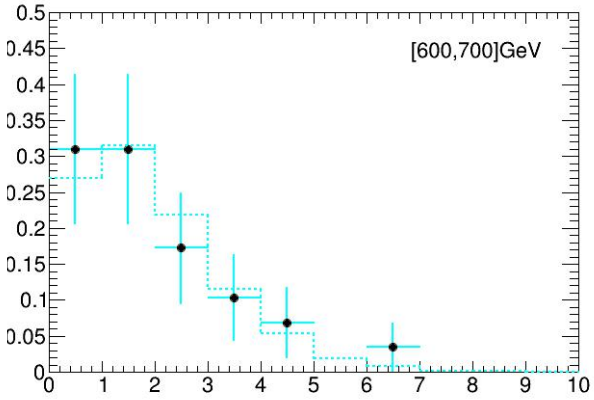








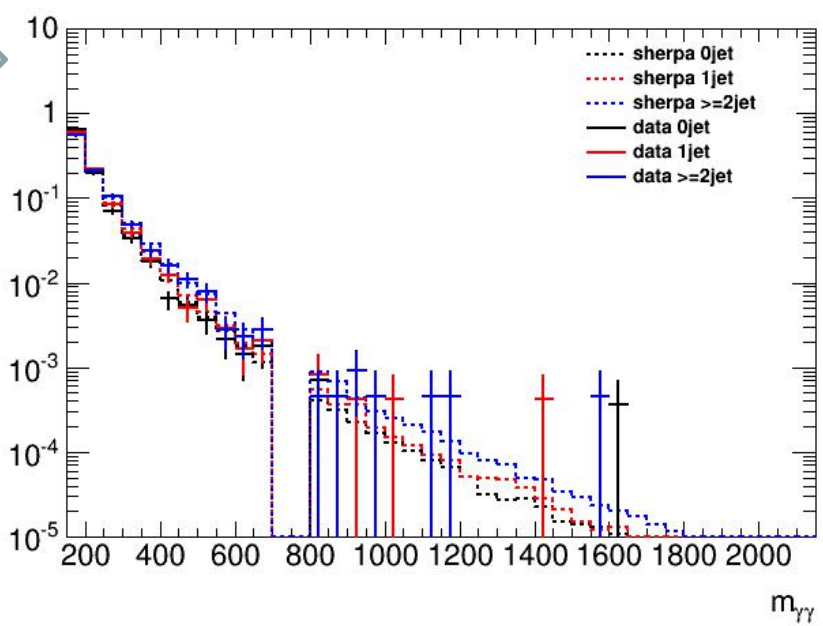


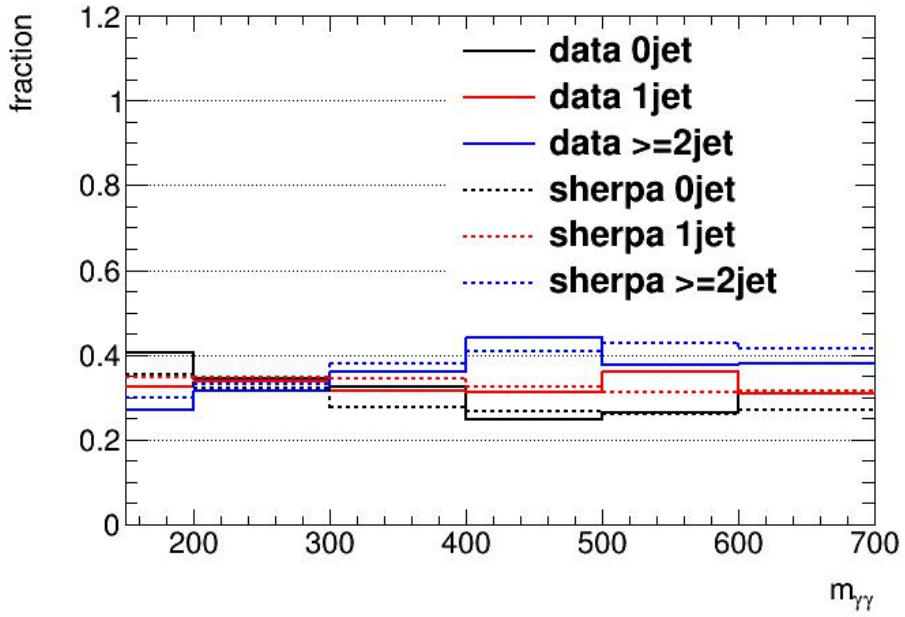


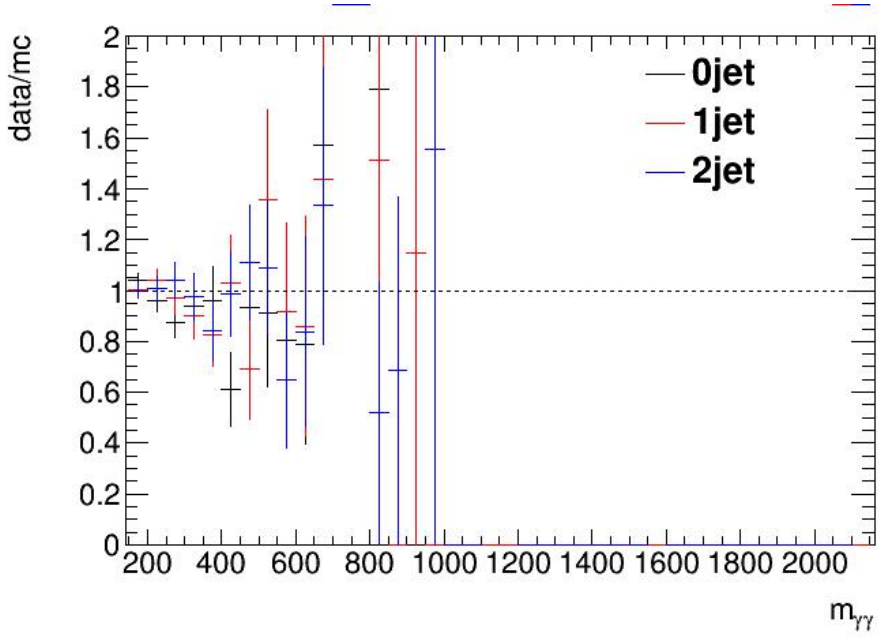
- solid line is data , dashed iline is MC
- statisitc error is dominant in high mass region

fraction of jet component

- bkg shape in jet cat
- fration of jet cat in mass bin

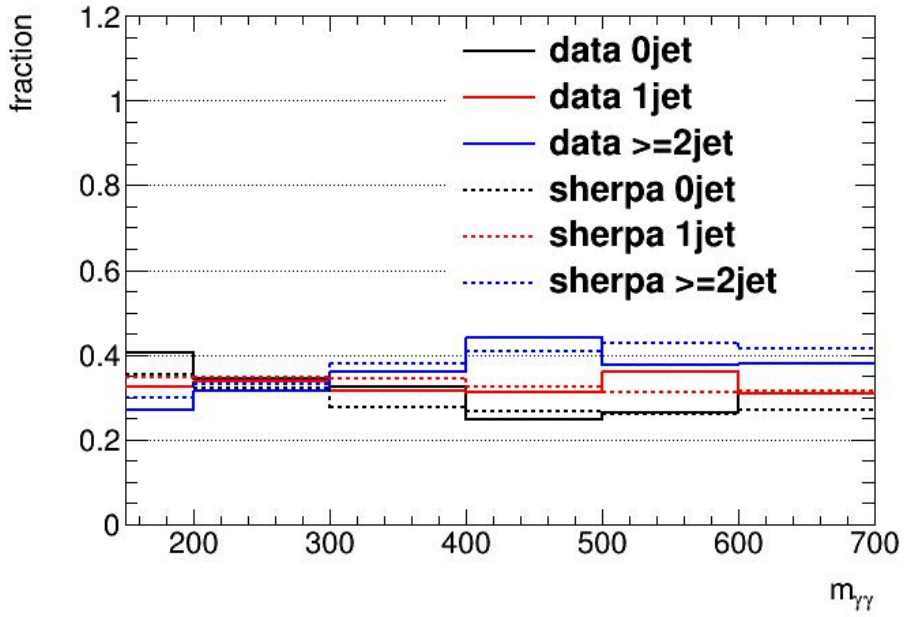


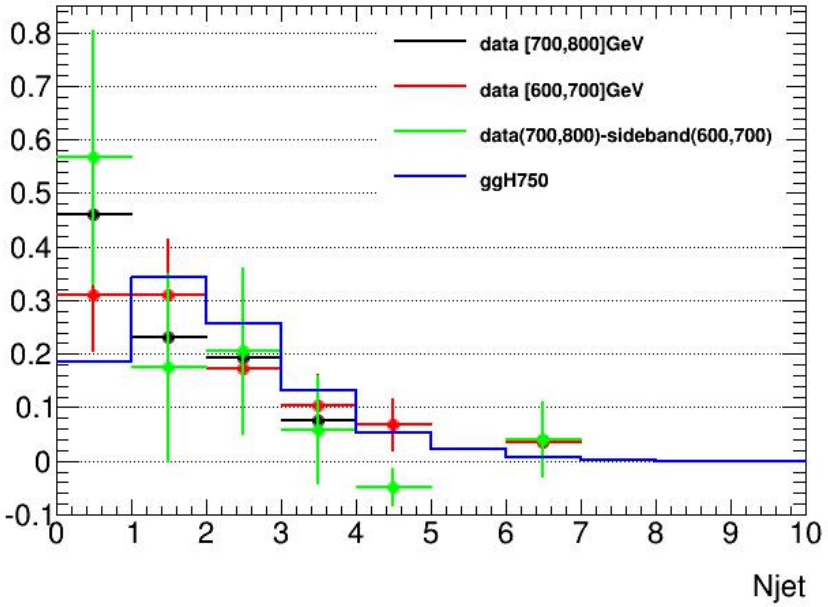




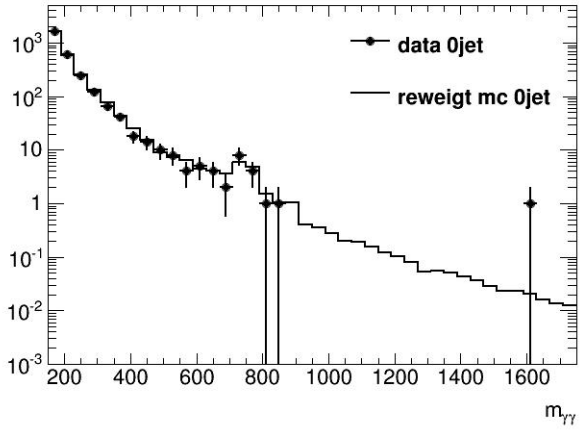
reweight

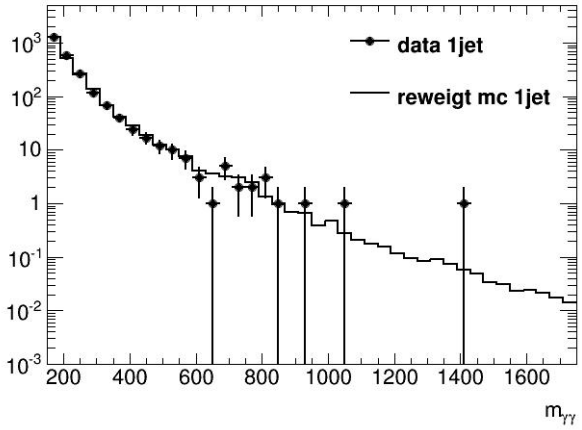
- take the distribution of jet multiplicity in [600,700] as that in [700,800]
- data-sideband as signal distribution
- scale MC signal to data-sideband
- reweight number of jet in diphoton MC

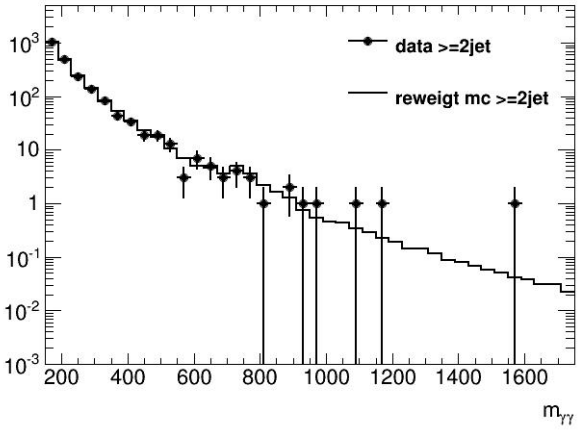




result







- count the signal and bkg yield in [700,800]

	0jet	1jet	>=2jet	reweight inclusive	inclusive
signal	8.86	2.81	4.23	15.90	16.12
bkg	3.28	3.88	6.00	13.16	12.77
significance	3.75	1.29	1.56	3.77	3.82
combined		4.26		improve: 13%	improve: 11.5%

result

- jet multiplicity reweight on signal and bkg(diphoton)
- count the signal and bkg number in [700,800]GeV
- before reweight

	inc	0jet	1jet	>=2jet	BB	nBB
signal	16.12	2.89	5.50	7.33	5.79	10.33
bkg	13.16	3.28	3.88	6.00	3.11	10.05
signif	3.82	1.42	2.36	2.70	2.67	2.86
comb	3.82	3.85(improve:0.79%)			3.91(2.36%)	

- only reweight signal

	inc	0jet	1jet	>=2jet	BB	nBB
signal	15.90	8.86	2.81	4.23	5.68	10.22
bkg	13.16	3.28	3.88	6.00	3.11	10.05
signif	3.77	3.75	1.29	1.57	2.63	2.83
comb	3.77	4.27(improve:13.26%)			3.86(2.39%)	

result

- only reweight signal

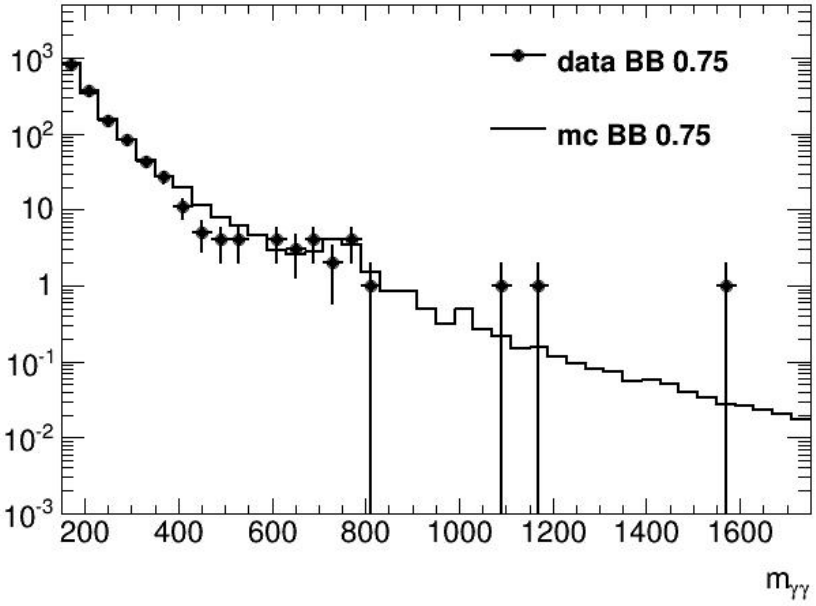
	inc	0jet	1jet	>=2jet	BB	nBB
signal	15.90	8.86	2.81	4.23	5.68	10.22
bkg	13.16	3.28	3.88	6.00	3.11	10.05
signif	3.77	3.75	1.29	1.57	2.63	2.83
comb	3.77	4.27(improve:13.26%)			3.86(2.39%)	

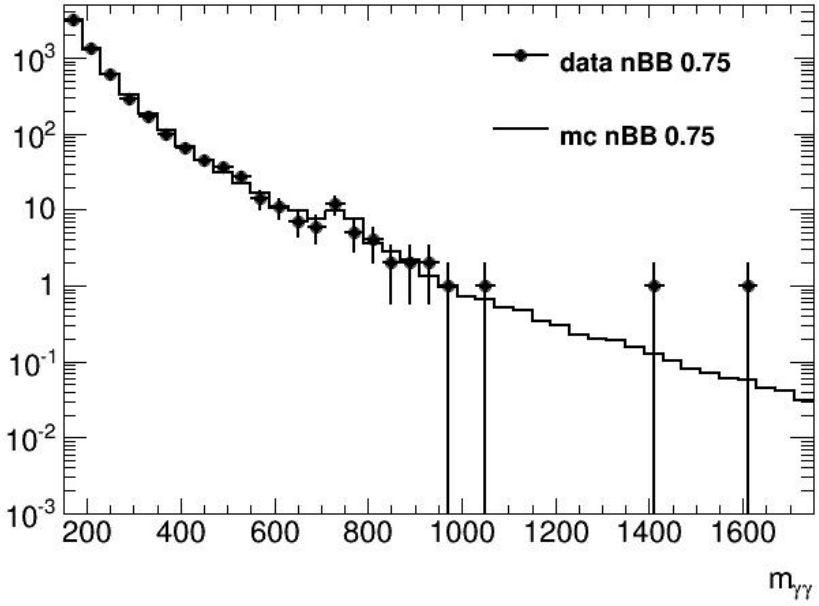
- reweight both signal and bkg(diphoton)

	inc	0jet	1jet	>=2jet	BB	nBB
signal	15.90	8.86	2.81	4.23	5.68	10.22
bkg	13.11	3.78	3.82	5.51	3.09	10.02
signif	3.78	3.58	1.30	1.62	2.63	2.83
comb	3.78	4.14(improve:9.52%)			3.86(2.39%)	

eta category

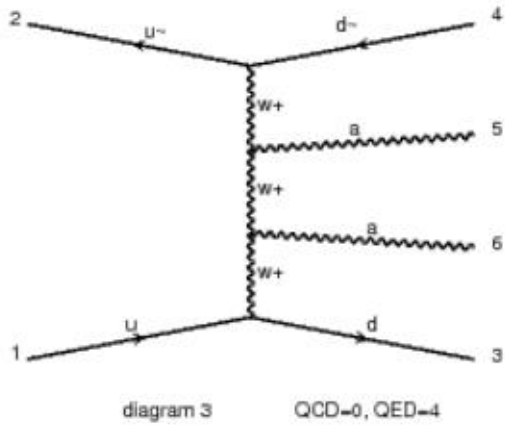
- According study from other group, it seems that mc is higher than data in some region and it results in lower significance.
- The improvement in eta category needs to be compared with other group:
- https://indico.cern.ch/event/527796/ (Wednesday)
- https://indico.cern.ch/event/522132/ (Tuesday)
- Hongtao's result seems still ~15%
- https://indico.cern.ch/event/527796/contributions/2165185/attachments/1271237/1885236/eta_categorization_update_wisconsin.pdf





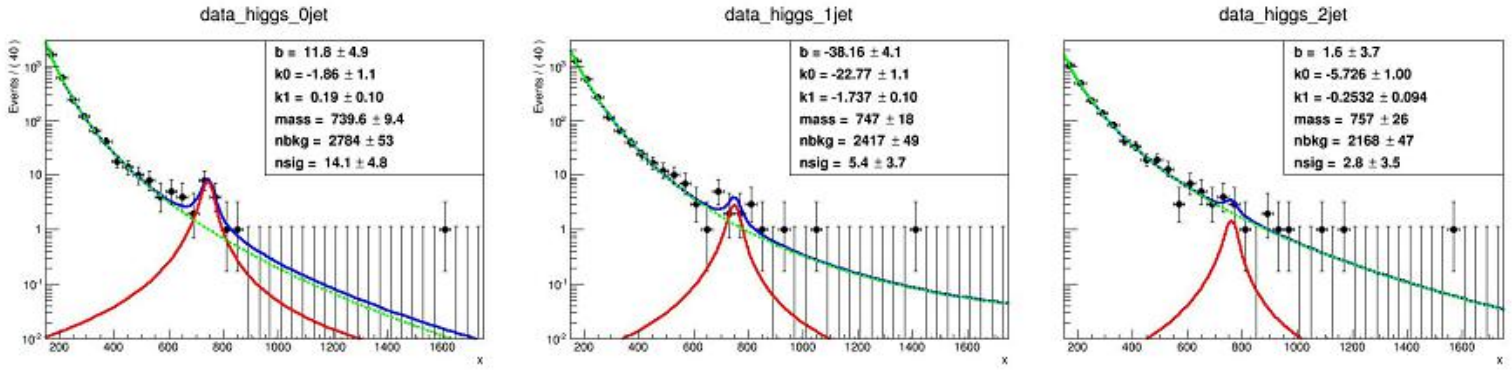
Summary

- Zgam
  - determine the dijet combination
  - use photon pt and mjj to do the first optimization
  - upper limit is 221fb (I think it is 68% upper limit...)
- 750GeV diphoton
  - with mc based method , ~10% improvement in jet category after jet multiplicity reweight , while ~2% improvement in eta category .
- to do
  - Zgam:
    - test further selection
    - do CB+GA fit and obtain the resolution
  - 750 diphoton: spurious signal and fit quality
  - VBF : estimated the contribution of NLO EW background



back up---fit on data

0jet, 1jet, >=2jet



- data

	0jet	1jet	>=2jet	inclusive
signal	10.32	3.95	2.04	16.27
bkg	2.53	3.24	5.65	11.52
significance	4.59	1.89	0.82	4.05
combined		5.03		improve:24%