	SM	Produced	scale	After cut number	After scale number	Efficiency (%)
ff_h_inv	1079	199863	0.0054	2679	14.48	1.342
$e^+e^- \to e^+e^-$	123854500	4000000		0	0	
$e^+e^- \to \mu^+\mu^-$	26663550	4000000	6.666	3321	19926	0.083
$e^+e^- \to \tau^+\tau^-$	23764450	4000000	5.941	973	4865	0.024
$e^+e^- \to \nu_\mu\bar{\nu}_\mu$	22081500	1986079		0	0	
qq	270534300	9999023	27	9	243	0
Sw_l	4363150	4406821		0		
Sw_sl	13063100	13193720		0		
Sze_l	5502600	5556664	0.9903	1792	1775	0.032
Sze_sl	1580200	1595907		0		
Szeorsw_l	1247400	1259867		0		
Sznu_l	289950	319278	0.9081	1930	1753	0.605
Sznu_sl	728100	735398		0		
Ww_h	19127300	19482330	0.9818	2	2	0
Ww_l0ll	2018300	2036465	0.9911	7016	6954	0.345
Ww_sl	24234950	24476400	0.9901	1217	1205	0.005
Zz_h	2583350	2608138	0.9905	3	3	0
Zz_l	339050	499503	0.6788	1215	825	0.243
Zz_sl	2782450	2842121	0.9790	7326	7172	0.258
Zzorww_h	16089350	0		0		
Zzorww_l	2161400	2183002	0.9901	9930	9832	0.455
Z(2f)	After BDT	17760				
SV	After BDT	8510				
VV	After BDT	32190				

(Before BDT, scale background 2 times)

	ff_h_inv	VV	SV	2f
Generate	6644 ?/100%	54127958/100%	5875942/100%	8000000/100%
After cut	2679/40.32%	26709//0.049%	3722/0.063%	4294/0.054%
After BDT	1685/25.36%	174/0.000%	46/0.001%	96/0.001%
After scale	1685	32190	8510	17760
After fit?				

Question: How many signal are generated? Whether use the branch ratio 0.106%?

After BDT(scale before BDT, scale times =2)

S=1685 B=40664 B/S=24

2.

240 GeV

Higgs signal

Process	$\int L$	Final states	X-sections (fb)	Comments
Higgs signal	5 ab^{-1}	ffH	203.66	all signals
	5 ab^{-1}	e^+e^-H	7.04	including ZZ fusion
	5 ab^{-1}	$\mu^+\mu^-H$	6.77	
	5 ab^{-1}	$\tau^+\tau^-H$	6.75	
	5 ab^{-1}	$\nu\bar{\nu}H$	46.29	all neutrinos (ZH+WW fusion)
	5 ab^{-1}	$q\bar{q}H$	136.81	all quark pairs ($Z \to q\bar{q}$)

2 fermion backgrounds

The number of $\mu^+\mu^-H\_inv$ maybe (in SM):

$N_{\mu^+\mu^-H\_inv} = 5000 \times 6.77 \times 0.00106 = 35.881$

Our number after cut is N = 14.48

Select efficiency = $\frac{14.48}{35.881}$ = 0.404

Make signal scale is 1.

	SM	Produced	scale	After cut number	After scale number	Efficience(%)
ff_h_inv	1079	199863	1	2679	2679	1.342
$e^+e^- \to e^+e^-$	123854500	4000000		0	0	
$e^+e^- \to \mu^+\mu^-$	26663550	4000000	6.666	3321	4099630	0.083
$e^+e^- \to \tau^+\tau^-$	23764450	4000000	5.941	973	1070556	0.024
$e^+e^- \to \nu_\mu\bar{\nu}_\mu$	22081500	0		0		
qq	270534300	9999023	27	9	1667	0
Sw_l	4363150	4406821		0		
Sw_sl	13063100	13193720		0		
Sze_l	5502600	5556664	0.9903	1792	328704	0.032
Sze_sl	1580200	1595907		0		
Szeorsw_l	1247400	1259867		0		
Sznu_l	289950	319278	0.9081	1930	324630	0.605
Sznu_sl	728100	735398		0		
Ww_h	19127300	19482330	0.9818	2	370	0
Ww_l	2018300	2036465	0.9911	7016	1287778	0.345
Ww_sl	24234950	24476400	0.9901	1217	223148	0.005
Zz_h	2583350	2608138	0.9905	3	556	0
Zz_l	339050	499503	0.6788	1215	152778	0.243
Zz_sl	2782450	2842121	0.9790	7326	1328148	0.258
Zzorww_h	16089350	0		0		
Zzorww_l	2161400	2183002	0.9901	9930	1820741	0.455

S = 2679; B = 10663519

B/S = 3980

After BDT (scale before BDT, scale times = 1)

S = 1967; B =353535

B/S = 180

2.Calculate branch ratio and upper limit(test)

(Don’t attend scale background)

1).Selected effectiveness = $\frac{2679}{199863\times\frac{6.77}{203.66}} = 0.4032$

(Come from the below pictures)

Fig1.cut signal (ffH_invi) numbers

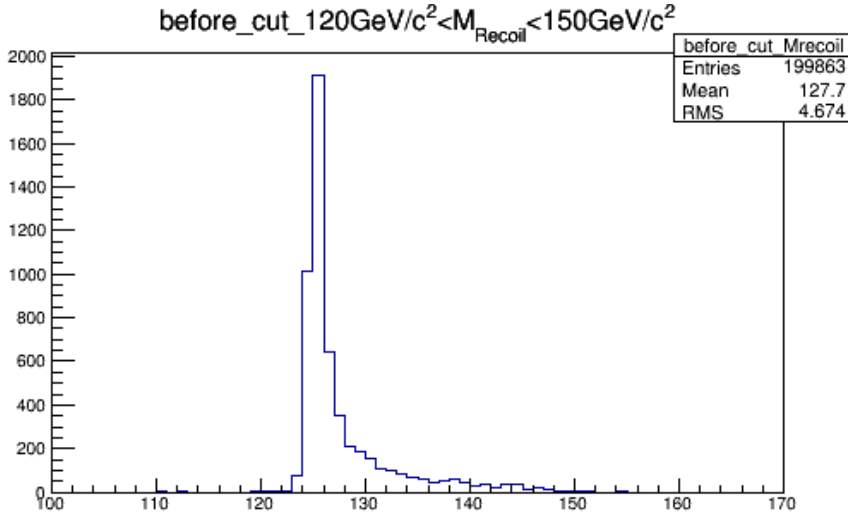
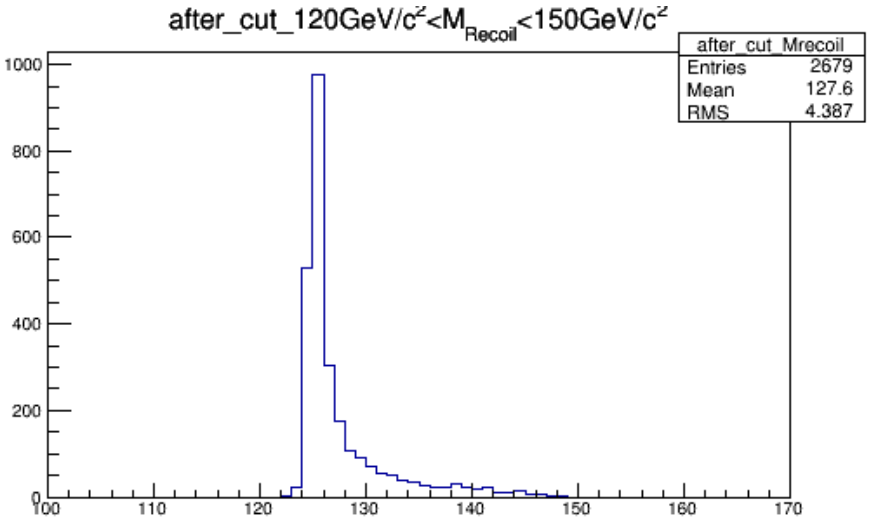


Fig2.Leave numbers ($\mu^+\mu^-H\_invi$)



If use BDT, effectiveness

= $\frac{1996}{199863\times\frac{6.77}{203.66}} = 0.3$ (Unable to fix, choose which one?)

2).Fitting:

Use two Gaussian to fit.

Fig1. Background (Because I have change some cut information. So the BDT maybe don't the best. After scale, the number of background will become 244015.)

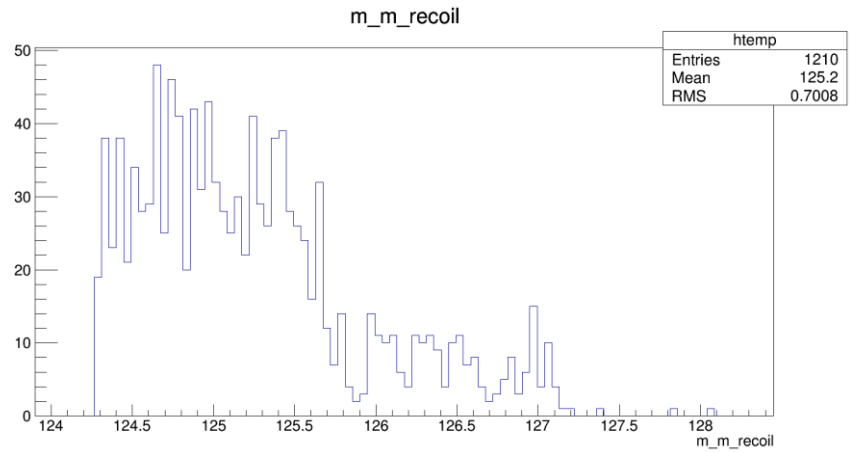
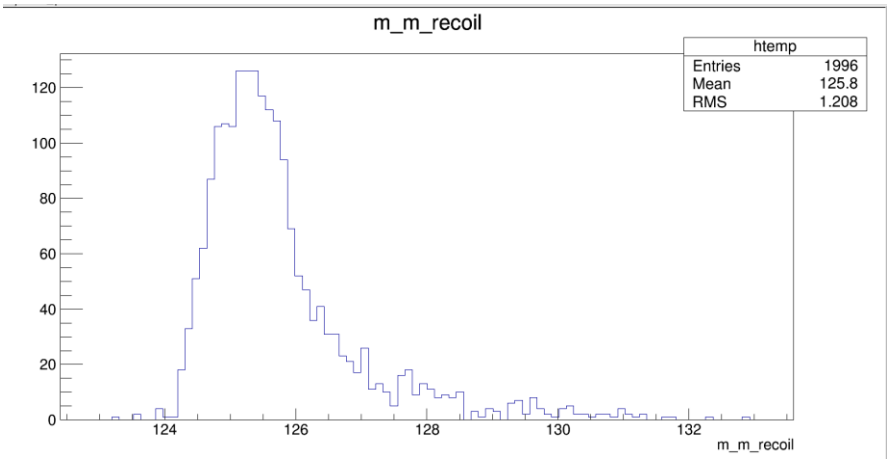


Fig2. Signal.



Whether two Guassian fit can work?

Fig3.Signal + background.

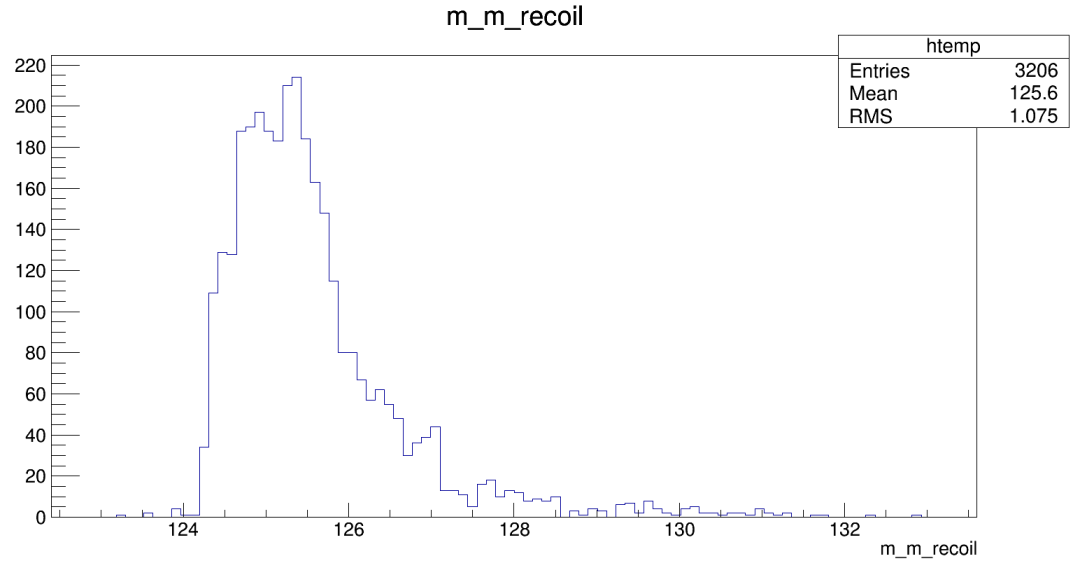
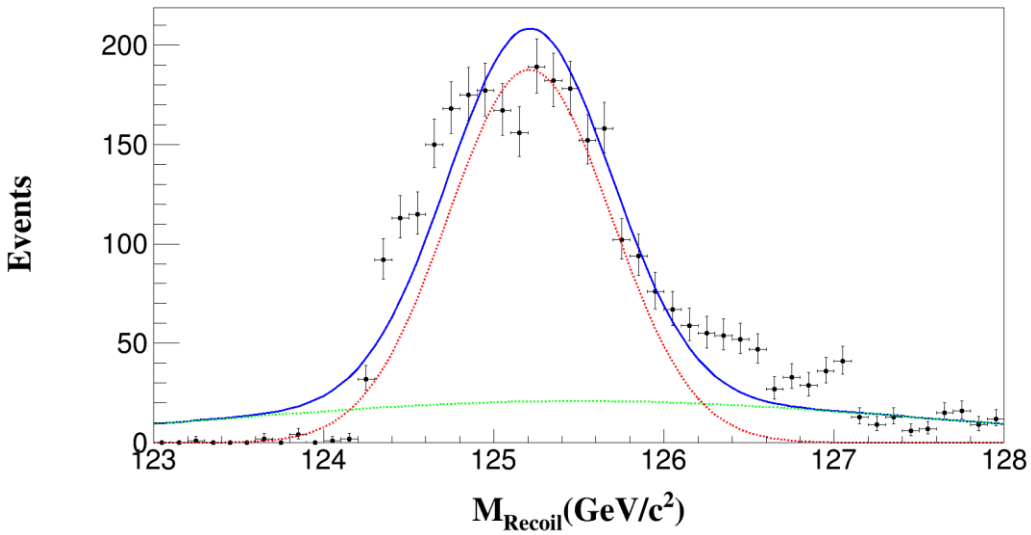


Fig4.Fit picture.(red line is signal,and green line is backround, and blue line is signal + background)



(Fit need to learn.)

After fitting, nsig=2256.98±58.1636

Nbkg=829.117±44.2158

So:

Branch ratio

$$=\frac{N_{sig}/eff}{N_{total}}$$

$$=\frac{(2256.98\pm58.1636)/0.4032}{\frac{5000\times6.77}{0.0054}}$$

=0.09% ± 0.48%

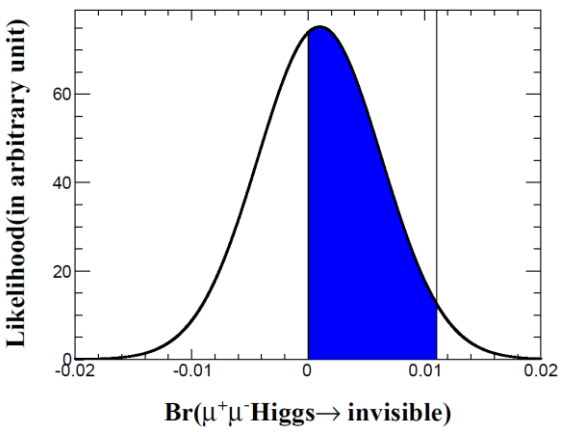
(How to calculate select effectiveness, I choose effectiveness after cut.)

3).Calculate upper limit

Branch ratio distribution obey Gaussian distribution, and mean value is 0.09% and sigma is 0.48%.

So The 95% confidence level upper limit is 1.00%.

Fig1.(upper limit)



Test results:

	$\mu^+\mu^- H(inv)$
Br	0.09%±0.48%
95%CL upper limit	1.00%

MoXin's result:

	$Z(e^+e^-)H(inv)$	$Z(\mu^+\mu^-)H(inv)$	$Z(q\bar{q})H(inv)$	Combined
Br	$0.35\pm0.510\%$	$0.350\%\pm0.290\%$	$0.094\%\pm0.150\%$	$0.103\%\pm0.075\%$
95% CL upper limit	1.30%	0.90%	0.37%	0.24%

4).Try to scale background (make it scale 185 times)

Question: Scale position.

(Maoqiang choose scale background after BDT, I think we should scale before BDT, but because our data two big and should spend many times and I will run this way this weekend.)

Fig1.Blue line is sig+bkg. Red line is signal. Green line is background. (fit picture)

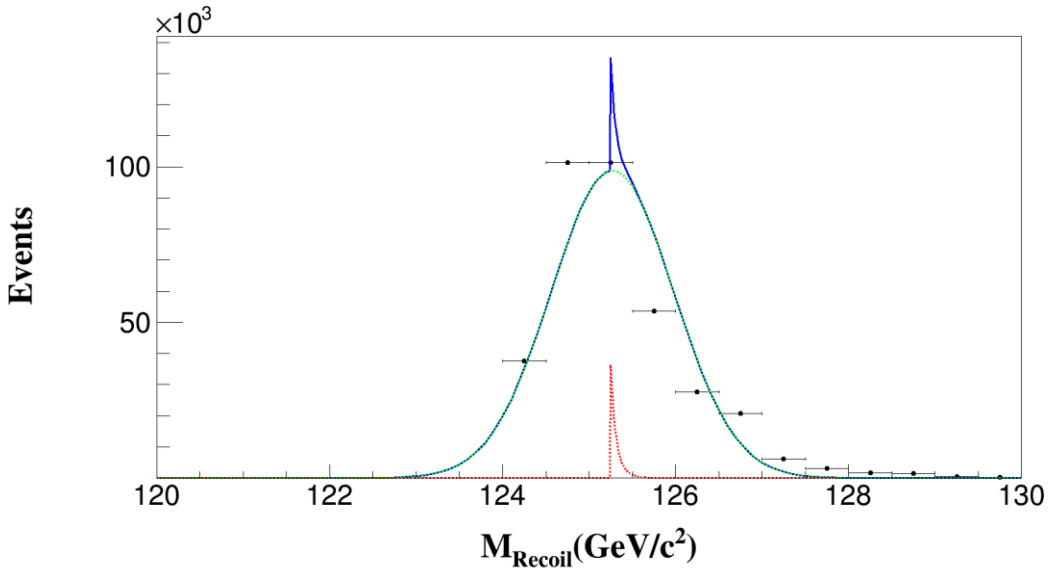


Fig2.signale add background distribution picture.

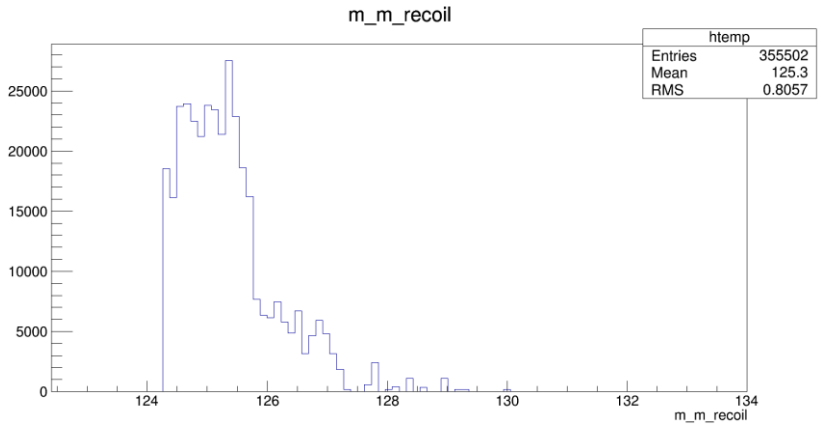


Fig3.Signal distribution.

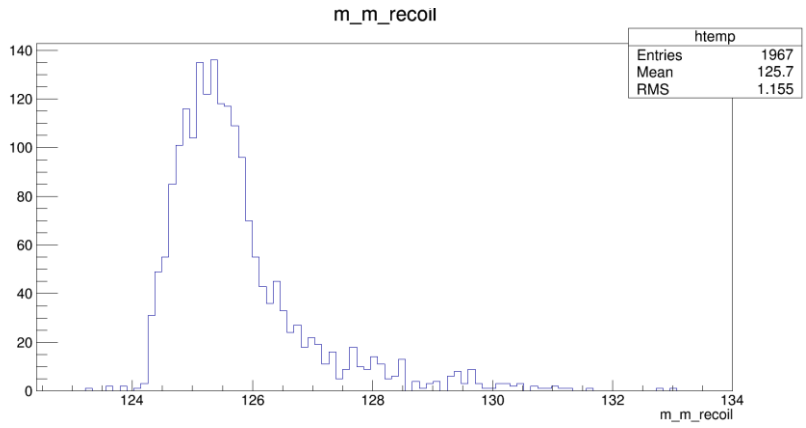
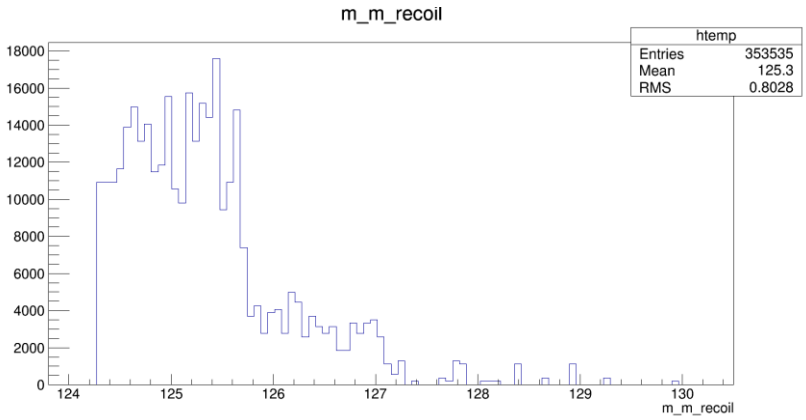


Fig4.Background distribution.



Question: Fit is strange and how to fit(only keep trying and change parameter….)?

Too strange(Fit wrong)

```
[#1] INFO:Plotting -- RooAbsPdf::plotOn(sum) indirectly selected PDF compon
RooRealVar::nsig = 4996.55 +/- 0.00152561  L(0 - 5000)
RooRealVar::nbkg = 354984 +/- 0.158852  L(0 - 355502)
Info in <TCanvas::Print>: pdf file fig/fithiggs.pdf has been created
```

Total:

Signal:1967

Background:355502

Question:BDT?

```
==> Wrote root file: ./BDT_output/bkg_e2E2h.root
==> TMVAClassification is done!
Error: Function TMVAGui(outfileName) is not defined in current scope  /cefs/higgs/tanyuhang/hig2inv/./BDT/Hin
*** Interpreter error recovered ***
```

Other good attemps: background extend 2 times before BDT (Maybe will try other method, BDT is magical, when change background numbers, event make it increase. After BDT, the results maybe better?).

B: 40664 S:1685 B/S= 2413.29

Fig1.Signal distribution.

(Maybe try to use CBshape to fit)

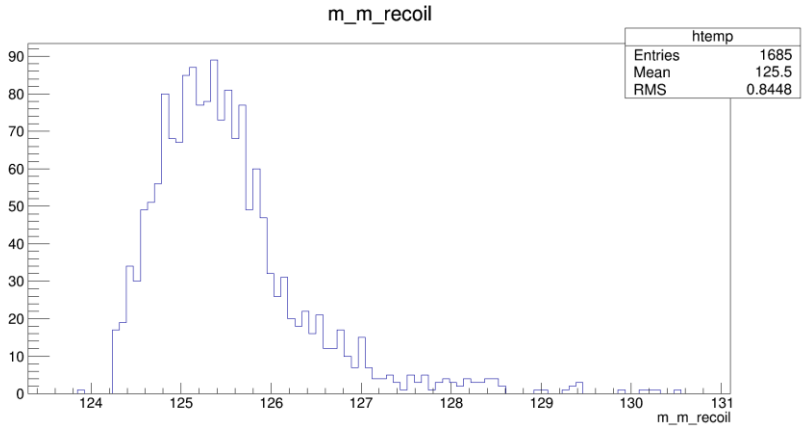


Fig2.Background distribution

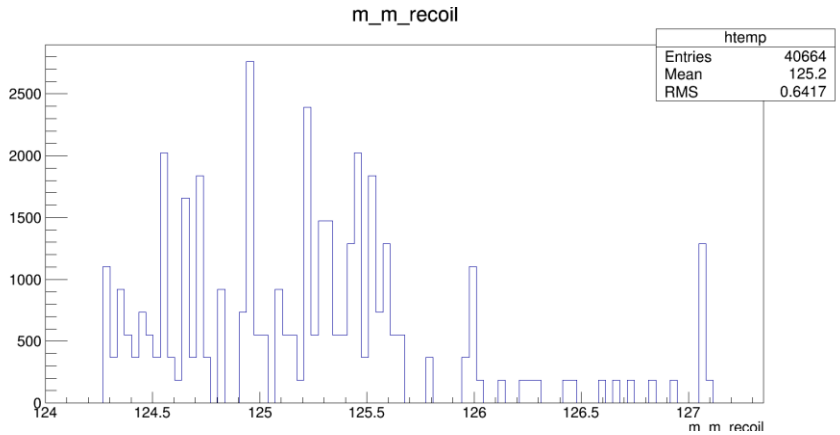


Fig3.

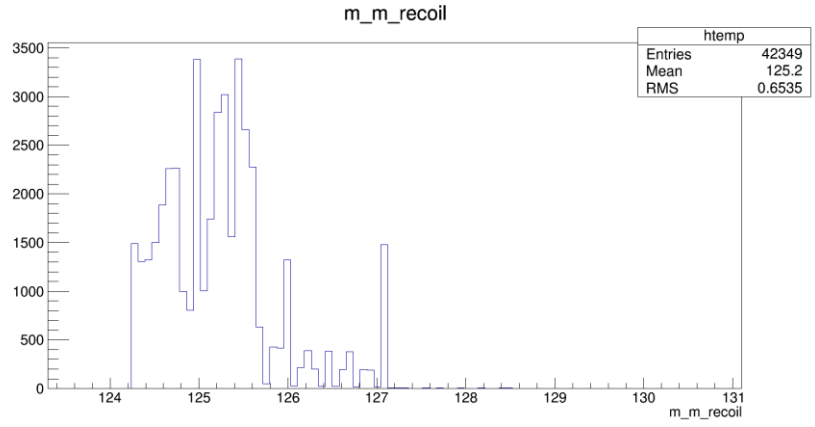
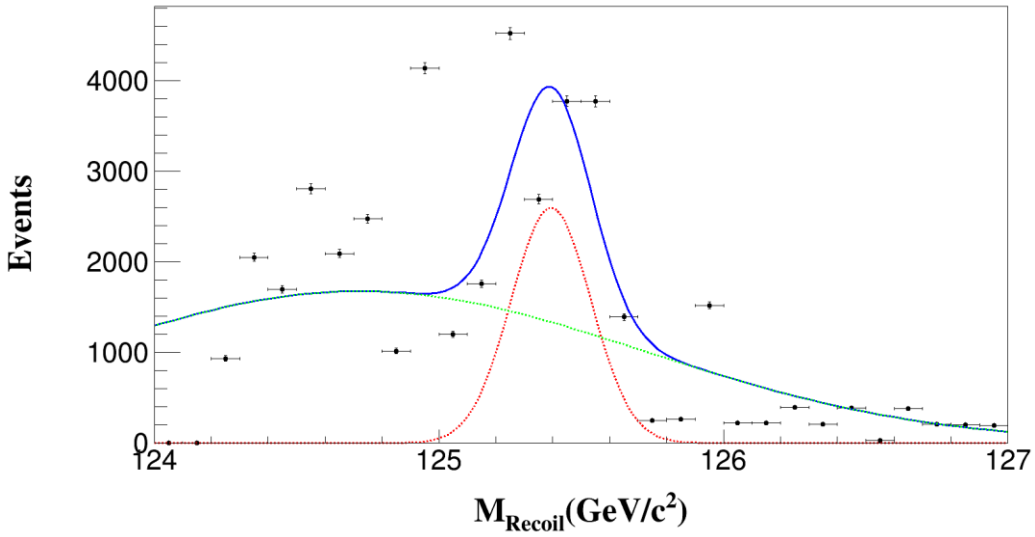


Fig.4 Fit: I don't know whether it's right and don't understand what fit is good?



I just use this to calculate upper limit as a test. (Hope some suggestions)

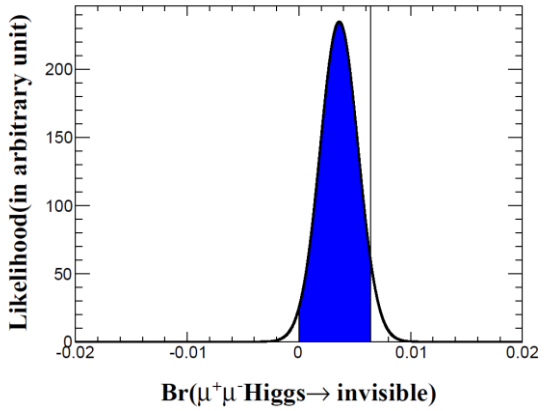
Branch ratio

$$= \frac{N_{sig}/eff}{N_{total}}$$

$$= \frac{(9000 \pm 7.18)/0.4032}{\frac{5000 \times 6.77}{0.0054}}$$

$$= 0.36\% \pm 0.17\%$$

Confidence level Upper limit = 0.64%



My result:

	$\mu^+\mu^- H(inv)$
Br	0.36%±0.17%
95%CL upper limit	0.64%

Moxin's

	$Z(e^+e^-)H(inv)$	$Z(\mu^+\mu^-)H(inv)$	$Z(q\bar{q})H(inv)$	Combined
Br	$0.35 \pm 0.510\%$	$0.350\% \pm 0.290\%$	$0.094\% \pm 0.150\%$	$0.103\% \pm 0.075\%$
95% CL upper limit	1.30%	0.90%	0.37%	0.24%

Next Plan:

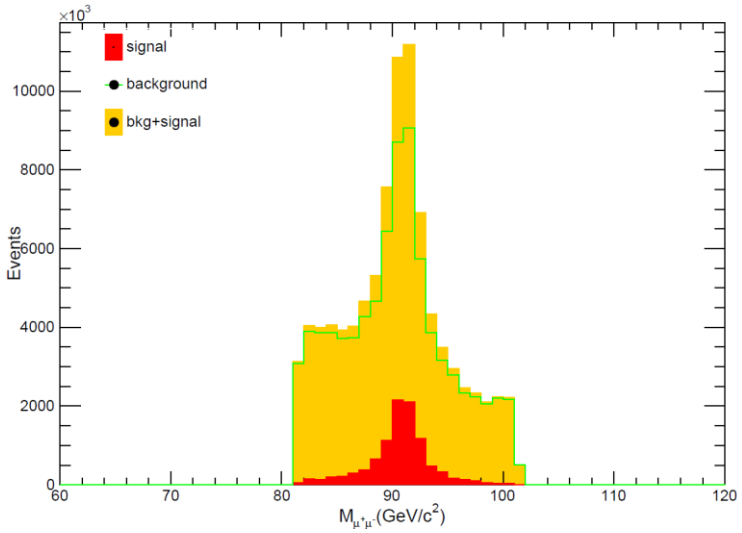
1. Many code question.(change many place and don't run all over again)
2. Don't understand the principle of BDT
3. Not understanding fit well.

1. Distribution between signal and back ground.

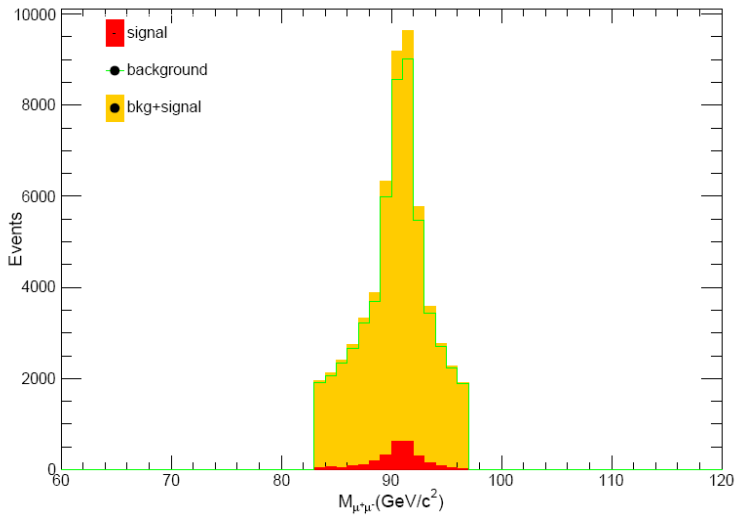
   (Because signal too small, I don't scale signal and extend 50 times background to see its distribution in before cut. After cut signal don't extend)

   Cut 83Gev< $M_{\mu^+\mu^-}$ <97Gev

   Before cut:

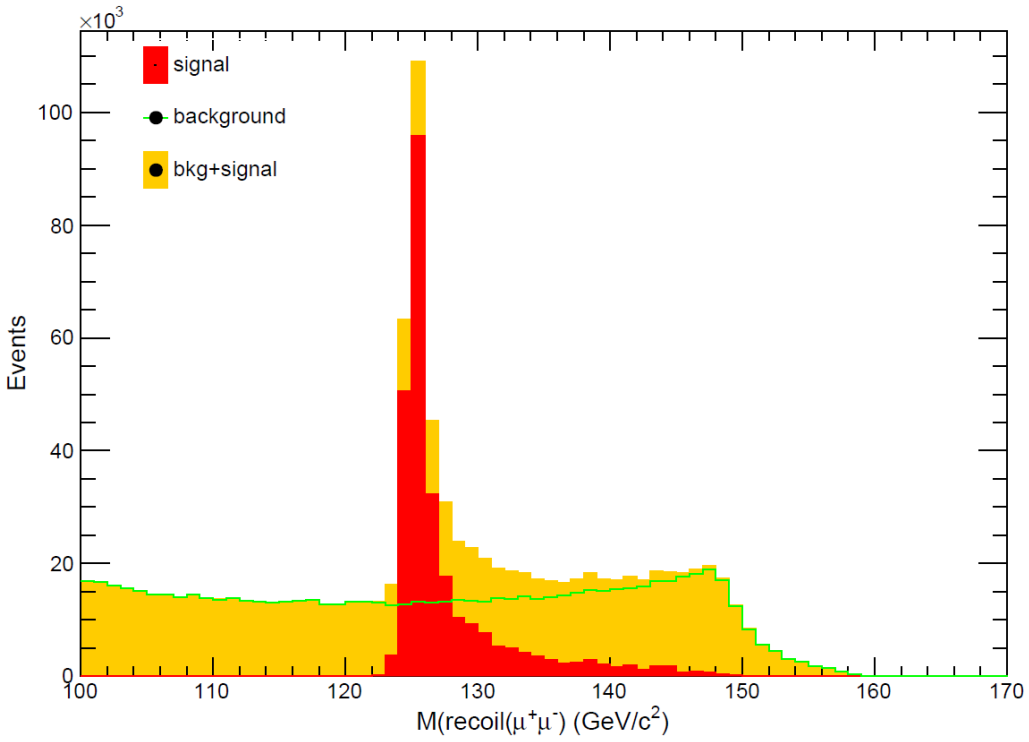


   After cut:

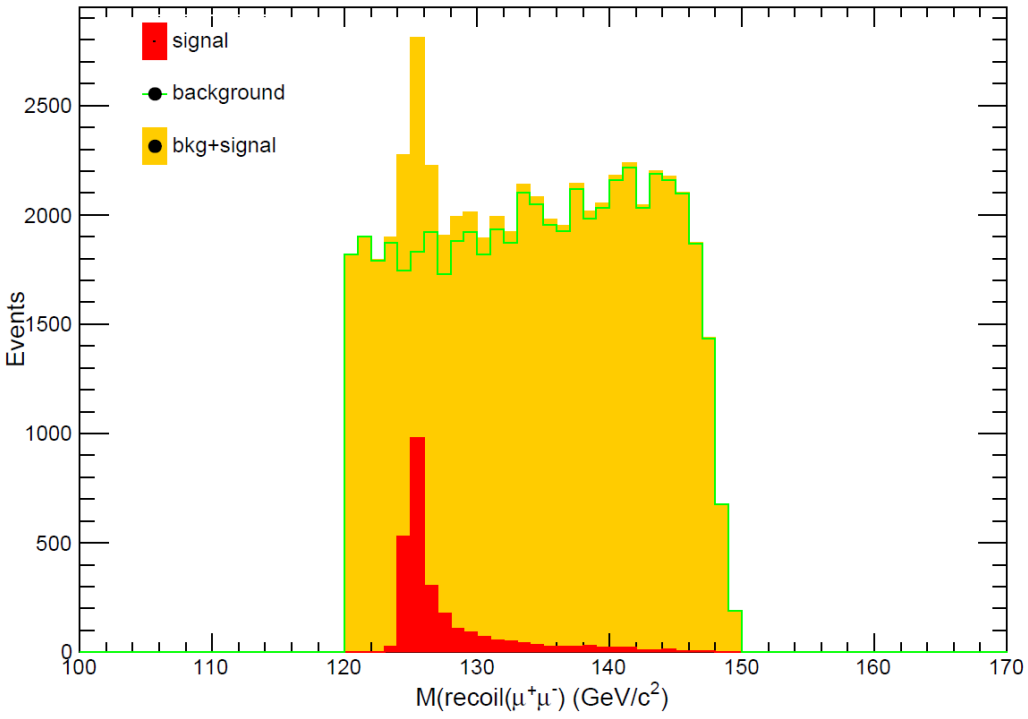


Cut 120Gev<M(recoil($\mu^+\mu^-$))<150Gev

Before cut:

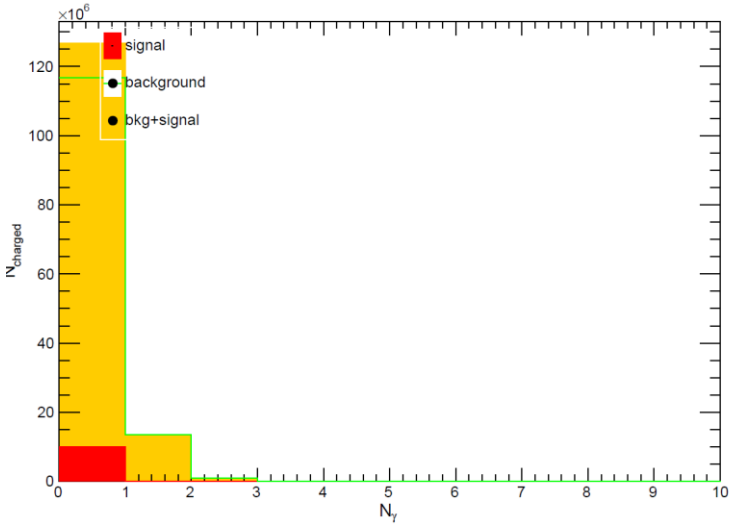


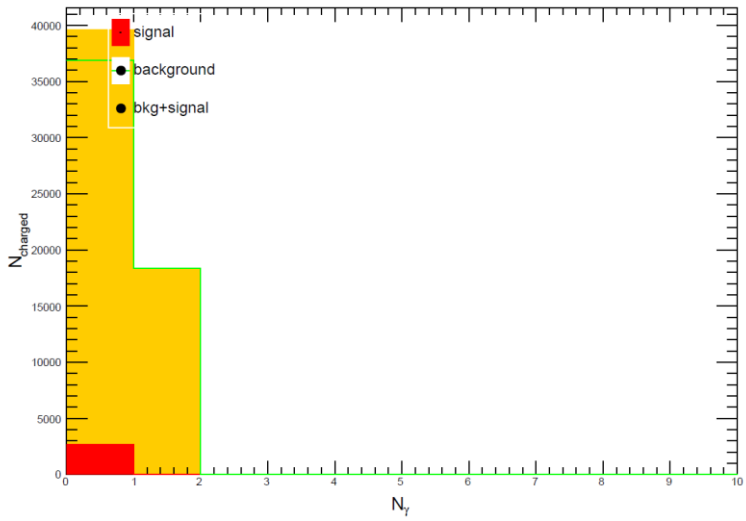
After cut:



Cut $N_\gamma \leq 1$

Before cut:





After cut: ($N_\gamma \leq 1$, why exist $N_\gamma = 2$)?

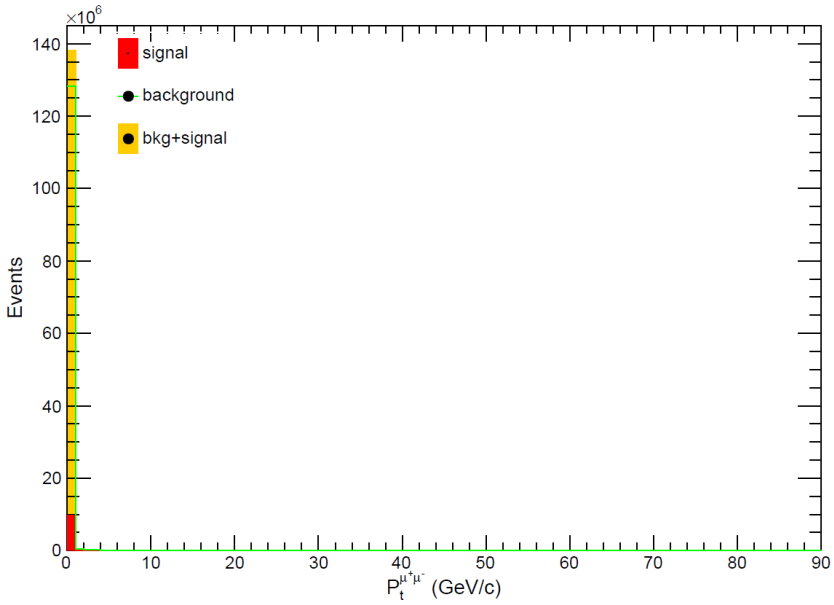
This my code:

```
if not (t_in.m_n_gamma<=1):
    return False
self.N[2]+=1
self.h_evtflw.Fill(2)
```

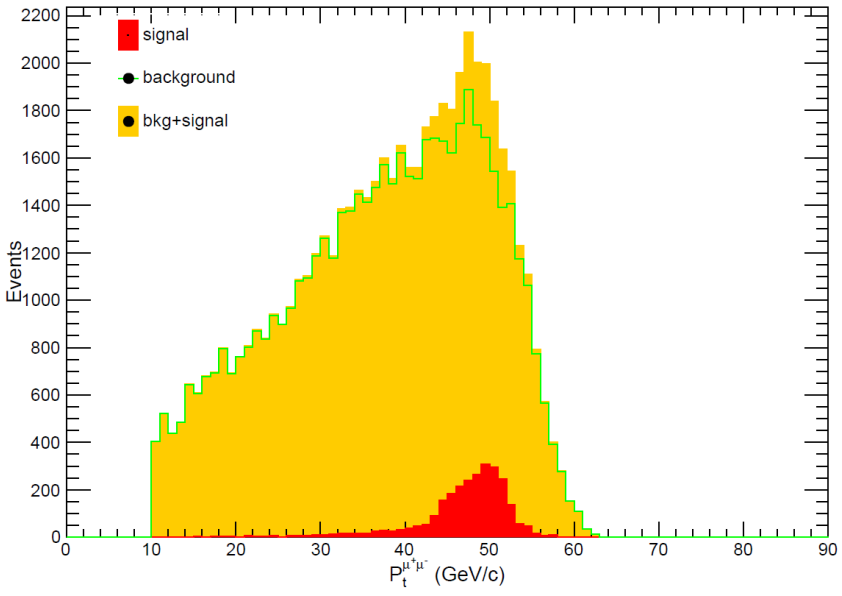
```
self.h_after_cut_n_photon.Fill(t_in.m_n_gamma)
```

Cut 10Gev< P_t<70Gev:

Before cut: (our signal conclude all ffH_invi, why choose this range?)

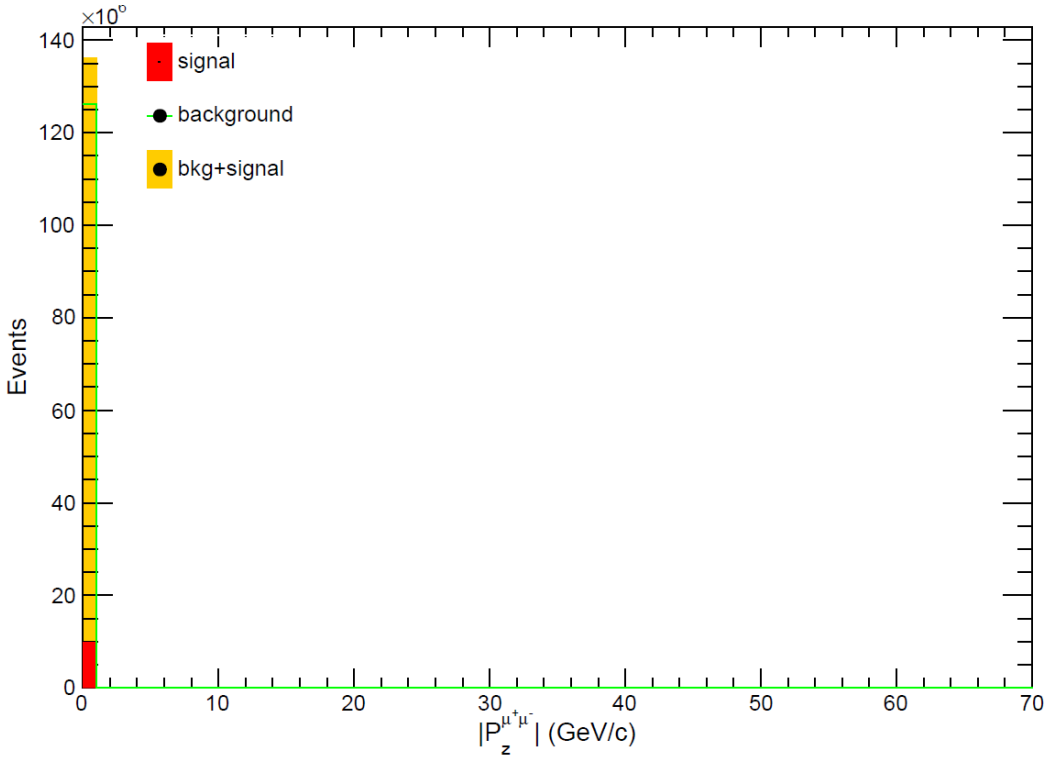


After cut:

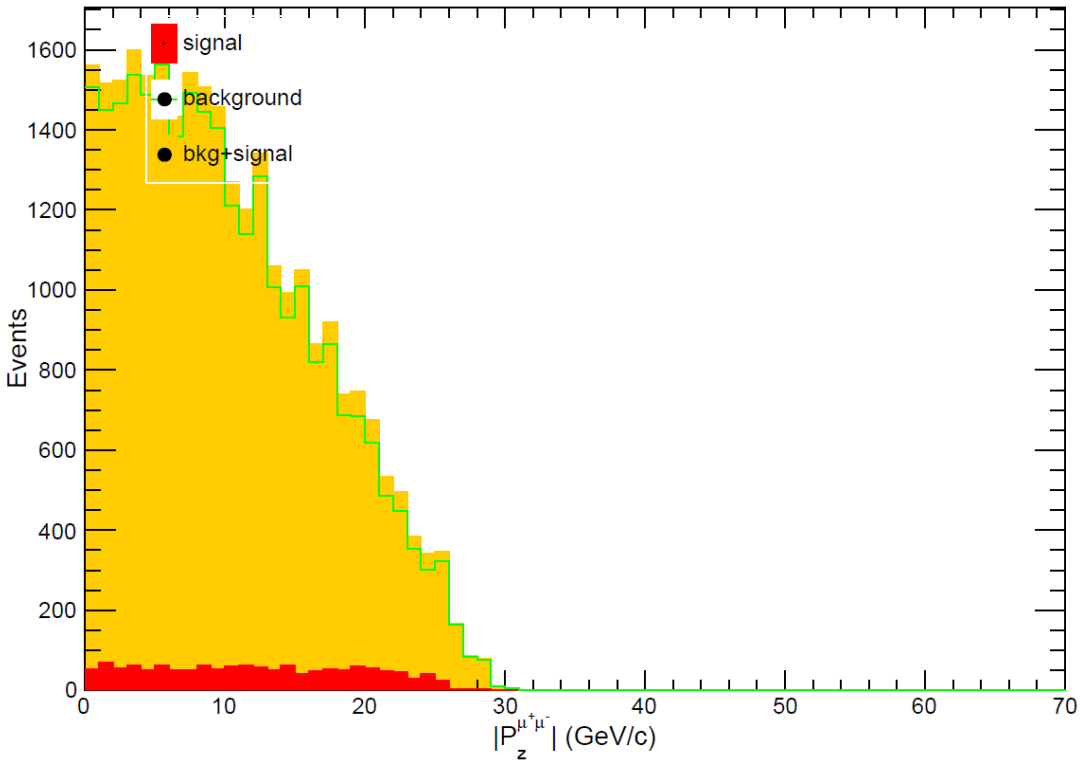


Cut P_z<50Gev

Before cut: (Maybe extend too large)

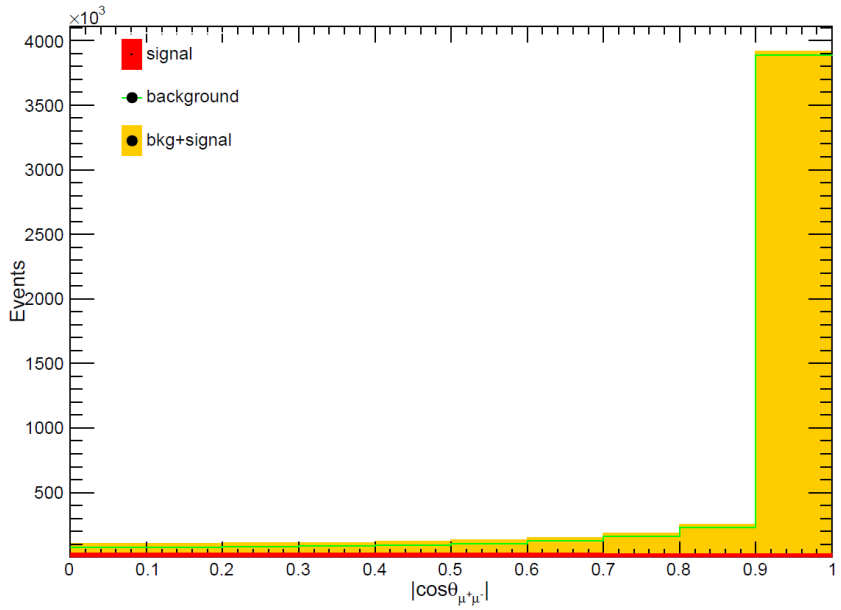


After cut:

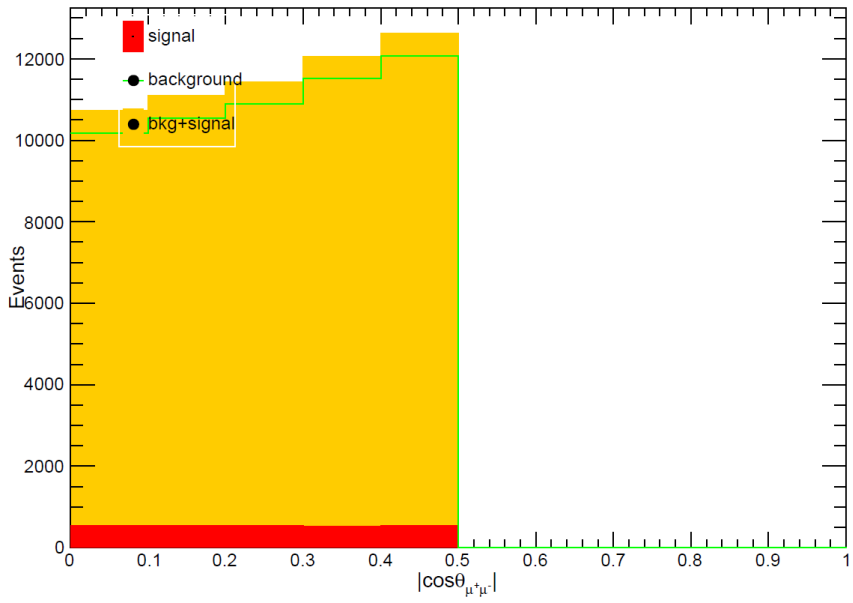


Cut $\left|\cos\theta_{\mu^+\mu^-}\right| < 0.5$

Before cut: (Different with Maoqiang, and change the Total P)

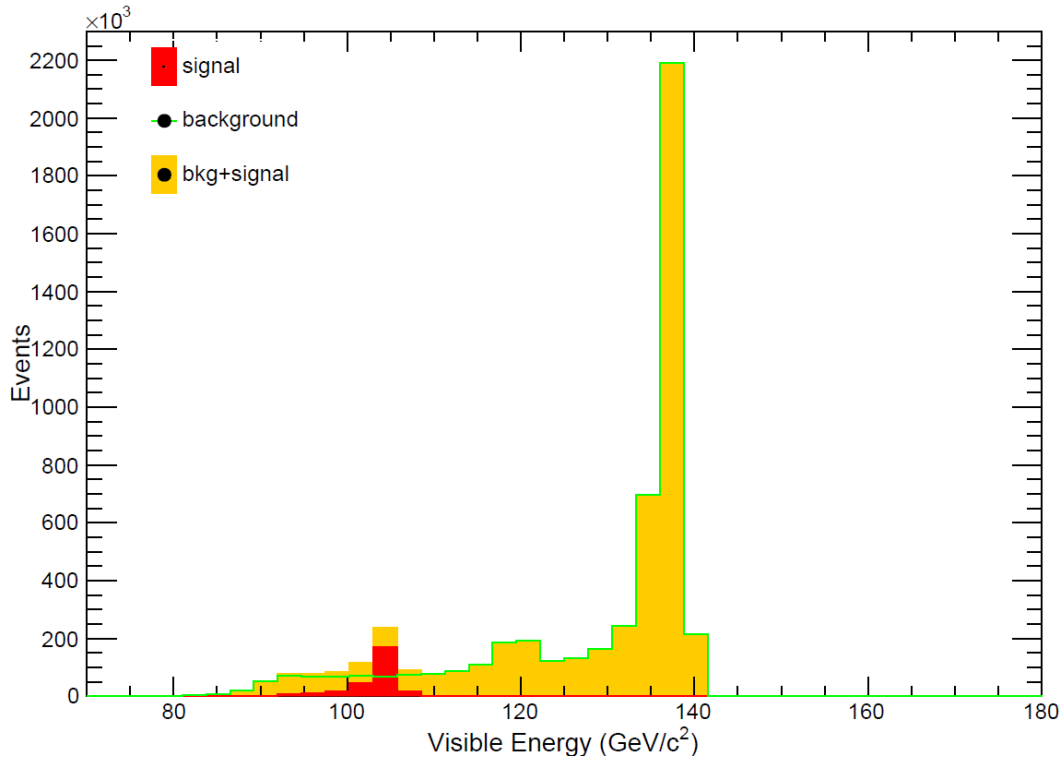


After cut:



Cut 90Gev<Visible energy<110Gev

Before cut: (Interesting second peak)



After cut: