Recoil mass analysis to prove performance not to be difference between SiECAL and ScECAL

June, 6, 2014
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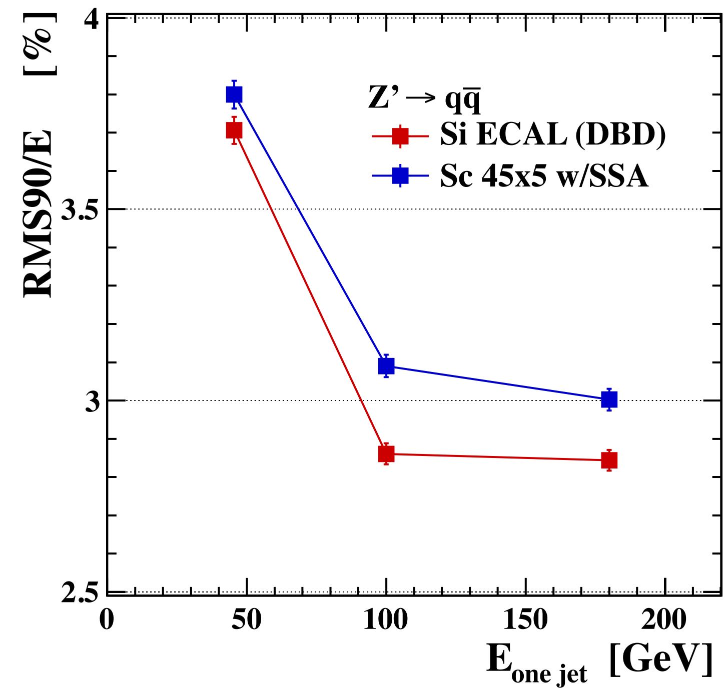
Today's report :
➡ Lepton channel at 350GeV with all cut base analysis.

My Motivation

- My motivation is to compare performance between SiECAL and ScECAL

- JER is slightly difference, ~ 0.3%
  but actually how about for physics analysis?

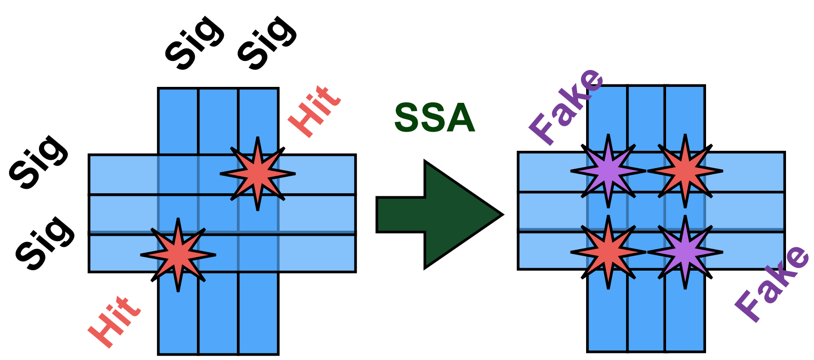


- For my fist test,
  I want to confirm whether the difference appear or not
  by using recoil mass analysis (μμ, ee, qq)

μμ → This does not depend on ECAL.

ee → This also does not depend on ECAL.

qq → This also does not depend on ECAL, I hope…



Nobody confirm these response, I try it.

Simulation condition & Analysis flow

- Analysis channel is μμ, ee, qq.

- $\sqrt{s}$ is 350GeV(L=350fb^-1), 250GeV(L=250fb^-1), 500GeV(L=500fb^-1).
  Beam polarization is (-0.8, +0.3)

- Signal is full simulated by using SiECAL and ScECAL.

- For now, I used BG reconstructed with SiECAL (DST sample).

  In case the difference does not appear for signal,
  it is expected that there is not difference against BG.

- Analysis flow is:

Lepton identification [Pre-selection]

↓

Good Z-paring with lepton candidates

(γ recovering, correction 14 mrad)

↓ ↓

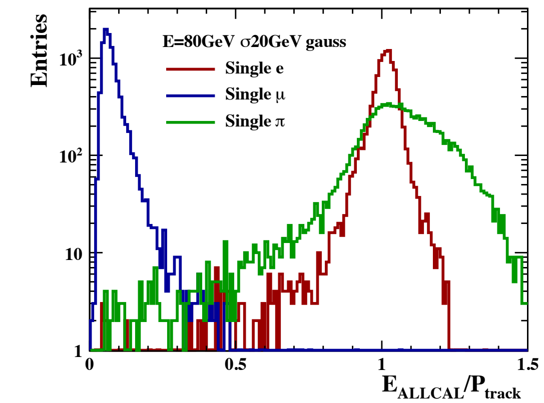
All Cut Base analysis | All MVA Base analysis

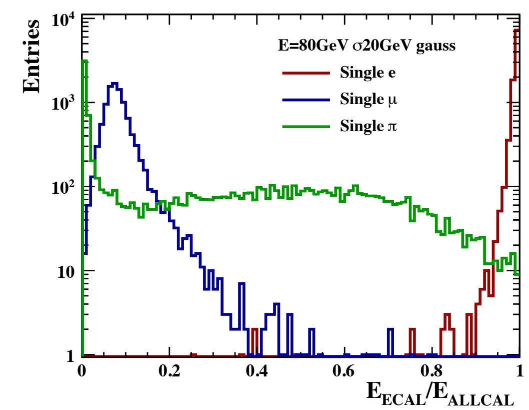
Lepton identification [Pre-selection]

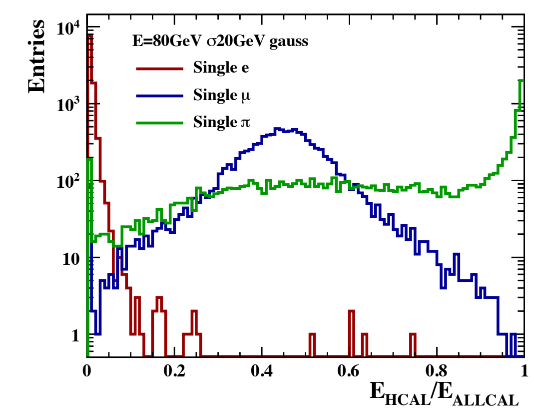
- Decide cut parameters from simulation of single particle injection.

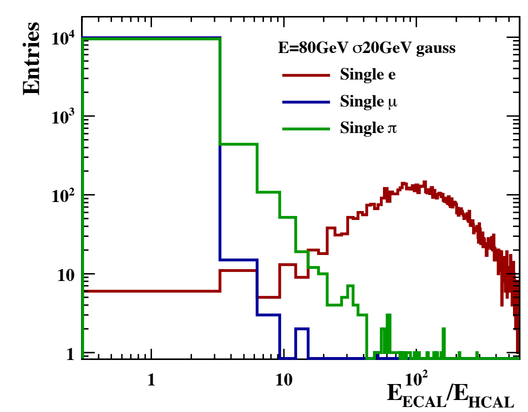
  Refer response of ECAL, HCAL, MUCAL, and P.

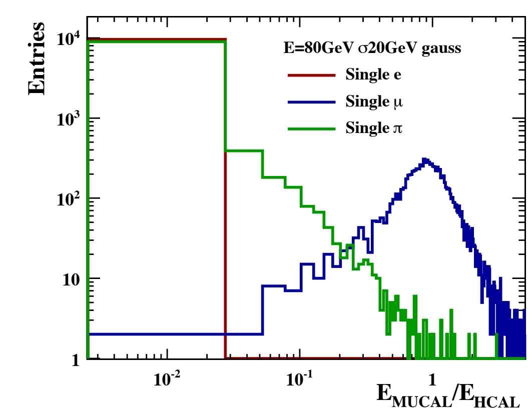
track_P >12GeV	e-ID	μ-ID
hcal_E / allcal_E	<0.95	<0.95
ecal_E / hcal_E	3<	<8
mucal_E / hcal_E	<0.03	0.05<
ecal_E / allcal_E	0.85<	<0.5
allcal_E div track_P	0.7<, <1.25	<0.5











- For 350GeV eeH/mmH signal events.

Si	e-ID	μ-ID
TRUE	50807	51987
id	50032	52346
true&&id	49409	51917
purity	97.25	99.87
efficiency	98.75	99.18

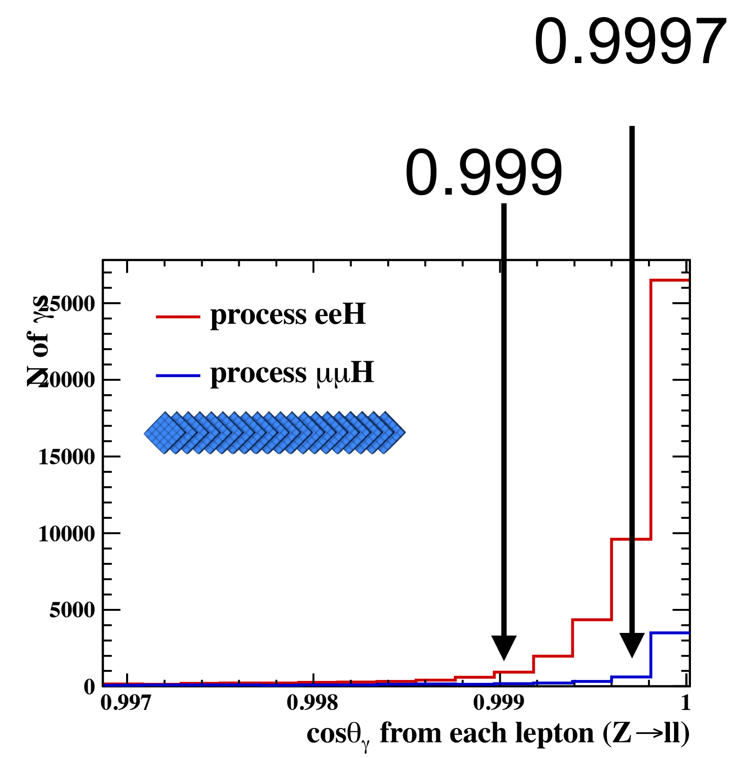
Sc w/ssa	e-ID	μ-ID
TRUE	50117	52337
id	49822	52027
true&&id	48691	51950
purity	97.73	99.85
efficiency	97.15	99.26

- Efficiency and purity are almost same.

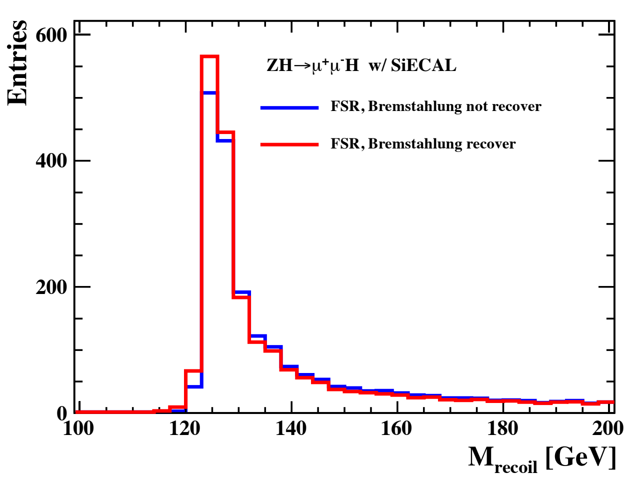
Gamma recovery [FSR, Bremstahlung]

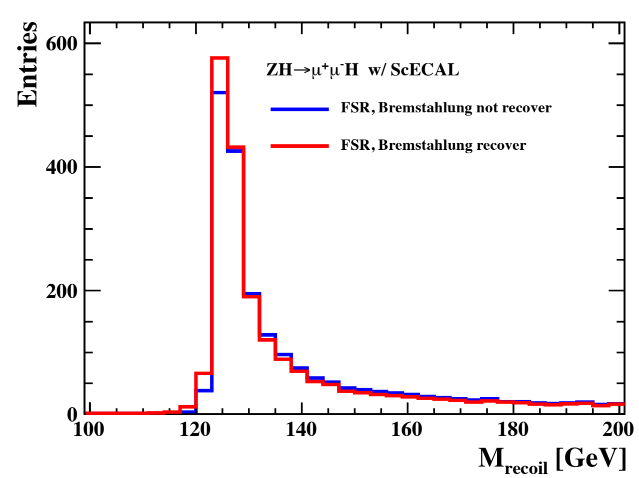
- After lepton identification, select the best lepton pair closest to Z mass.

- Apply gamma recovery.
  → cosθ between lepton and gamma > 0.9997

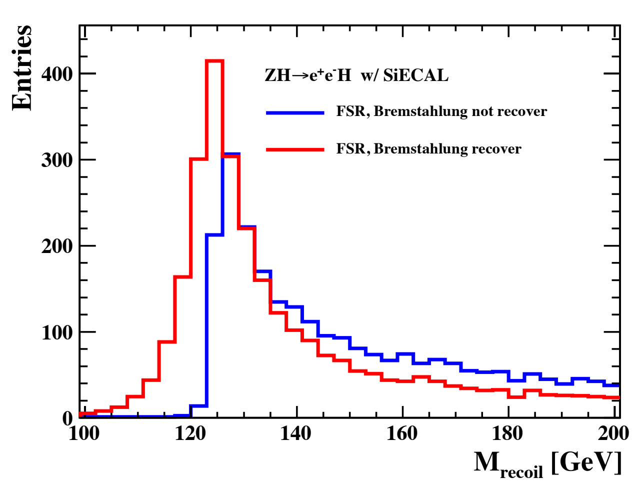


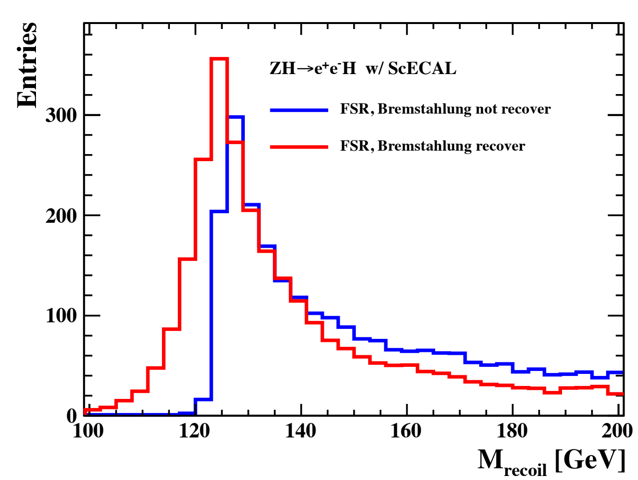
mmH





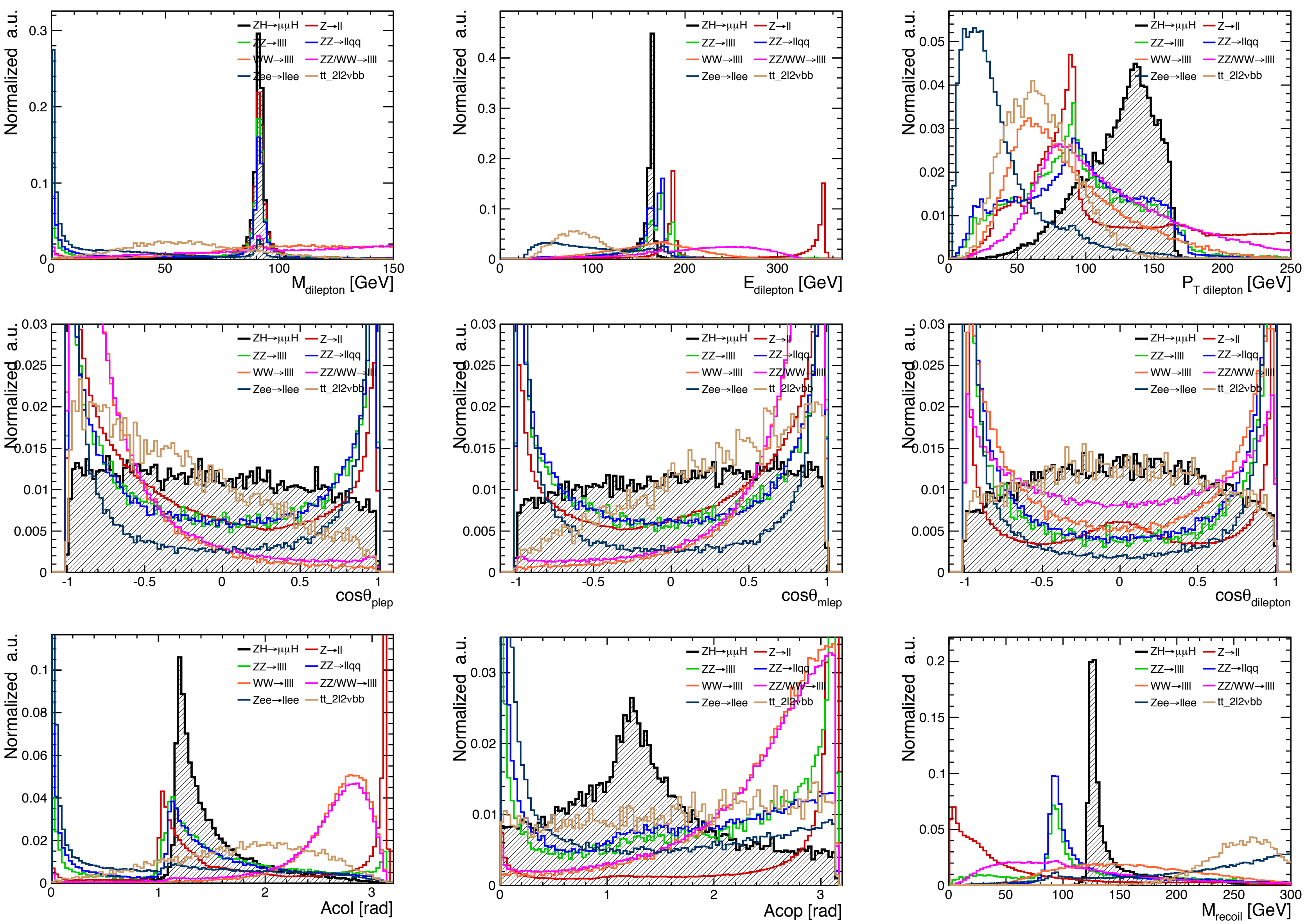
eeH





BG suppression

- With reference to a lower physical variables, applied BG suppression.
  Same cut value is applied to both eeh and mmh channels, also SiECAL and ScECAL



Range of rejection

costheta_m<-0.85
costheta_p>0.85
ptdilep<60 || 165<ptdilep
zmass<84 || 98<zmass)
acoplanarity<0.2 || 2.9<acoplanarity
acollinearity<1.15 || 2.5<acollinearity
abs(costhetaZ)>0.85
zenergy<150 || 168<zenergy
recoil<115 || 145<recoil

Not consider these variables yet

$|\cos\theta_{missing}|$, δPT_{bal}, …

Reduction table [Si and Sc]

mmH

: original events = 25000 ntuple Entries = 23802

pre-selection(both e/mu) ID	cut 1198	remaining (%) **95.208**
+ costhetamm cut	cut 1256	remaining (%) 90.184
+ costhetamp cut	cut 1170	remaining (%) 85.504
+ ptdilep cut	cut 397	remaining (%) 83.916
+ zmass cut	cut 2876	remaining (%) 72.412
+ acoplanarity cut	cut 1388	remaining (%) 66.86
+ acollinearity cut	cut 531	remaining (%) 64.736
+ costhetaZ cut	cut 1106	remaining (%) 60.312
+ zenergy cut	cut 2446	remaining (%) 50.528
+ recoil cut	cut 1199	remaining (%) **45.732**

original events = 25000 ntuple Entries = 23804

pre-selection(both e/mu) ID	cut 1196	remaining (%) **95.216**
+ costhetamm cut	cut 1255	remaining (%) 90.196
+ costhetamp cut	cut 1173	remaining (%) 85.504
+ ptdilep cut	cut 398	remaining (%) 83.912
+ zmass cut	cut 2897	remaining (%) 72.324
+ acoplanarity cut	cut 1390	remaining (%) 66.764
+ acollinearity cut	cut 538	remaining (%) 64.612
+ costhetaZ cut	cut 1113	remaining (%) 60.16
+ zenergy cut	cut 2438	remaining (%) 50.408
+ recoil cut	cut 1189	remaining (%) **45.652**

eeH

: original events = 24925 ntuple Entries = 21683

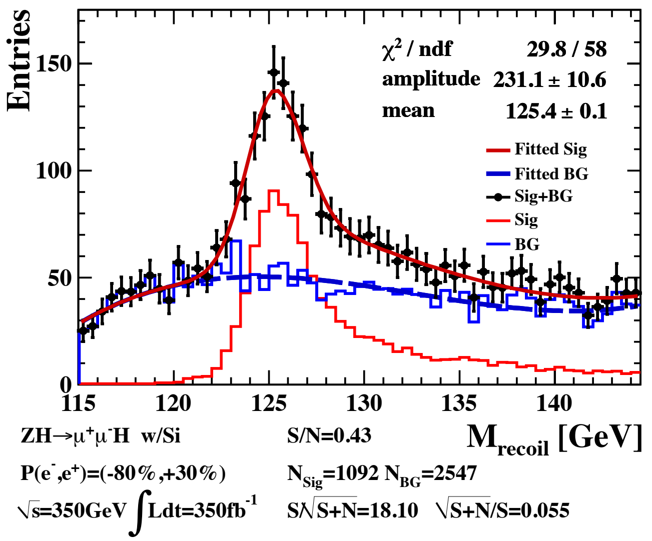
pre-selection(both e/mu) ID	cut 3242	remaining (%) **86.993**
+ costhetamm cut	cut 836	remaining (%) 83.6389
+ costhetamp cut	cut 771	remaining (%) 80.5456
+ ptdilep cut	cut 2222	remaining (%) 71.6309
+ zmass cut	cut 7019	remaining (%) 43.4704
+ acoplanarity cut	cut 878	remaining (%) 39.9478
+ acollinearity cut	cut 308	remaining (%) 38.7121
+ costhetaZ cut	cut 646	remaining (%) 36.1204
+ zenergy cut	cut 1560	remaining (%) 29.8616
+ recoil cut	cut 1377	remaining (%) **24.337**

: original events = 25000 ntuple Entries = 21047

pre-selection(both e/mu) ID	cut 3953	remaining (%) **84.188**
+ costhetamm cut	cut 803	remaining (%) 80.976
+ costhetamp cut	cut 742	remaining (%) 78.008
+ ptdilep cut	cut 2092	remaining (%) 69.64
+ zmass cut	cut 6902	remaining (%) 42.032
+ acoplanarity cut	cut 839	remaining (%) 38.676
+ acollinearity cut	cut 301	remaining (%) 37.472
+ costhetaZ cut	cut 657	remaining (%) 34.844
+ zenergy cut	cut 1509	remaining (%) 28.808
+ recoil cut	cut 1442	remaining (%) **23.04**

- The result of efficiency is almost same.

Recoil mass ZH -> mmH



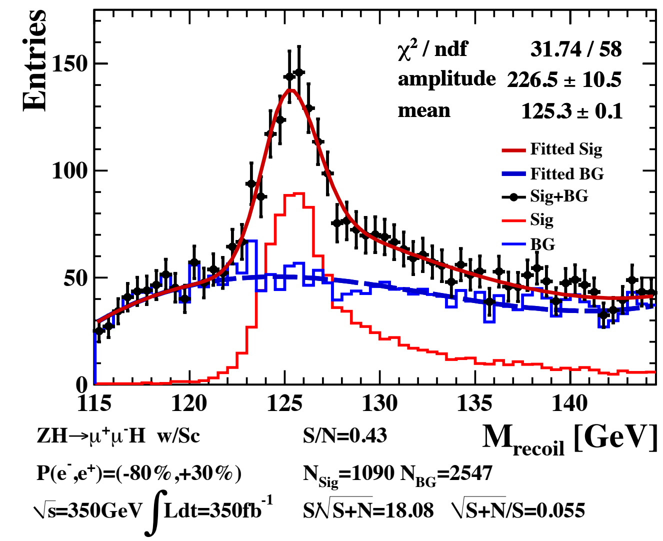
ε ~ 45.7%

Δm ~ 0.11GeV

σ_M/M ~ 1.19%

$\Delta\sigma_{HZ}/\sigma_{HZ}$ ~ 5.5%
(the number of events)

Toy MC (ampli)
$\Delta\sigma_{HZ}/\sigma_{HZ}$ ~4.8%



ε ~ 45.6%

Δm ~ 0.11GeV

σ_M/M ~ 1.16%

$\Delta\sigma_{HZ}/\sigma_{HZ}$ ~ 5.5%

Toy MC (ampli)
$\Delta\sigma_{HZ}/\sigma_{HZ}$ ~4.8%

model independence H ➡

45.5 ~ 49.8 %
except low statistics channel

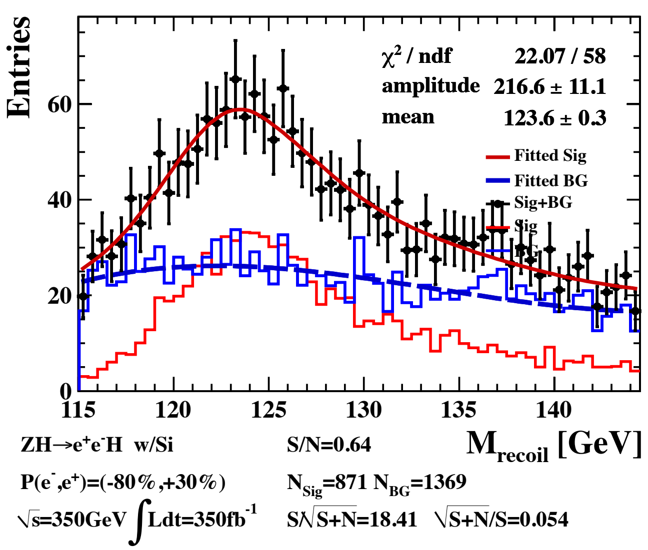
H➡	bb	cc	ss	ww llll	ww qqll	ww qqqq	zz llll	zz qqll	zz qqqq	γγ	gg	ττ	μμ
befo	13467	691	8	589	2339	2513	72	301	306	106	1615	1790	4
aft	6489	344	4	268	1104	1203	32	141	146	57	780	864	1
ε	48.2	49.8	50.00	45.5	47.2	47.9	44.4	46.8	47.7	53.8	48.3	48.3	25.00

45.6 ~ 49.8 %
except low statistics channel

H→	bb	cc	ss	ww llll	ww qqll	ww qqqq	zz llll	zz qqll	zz qqqq	γγ	gg	ττ	μμ
befo	13451	691	8	590	2333	2529	72	299	304	107	1627	1788	4
aft	6467	342	4	269	1105	1208	34	138	145	60	779	861	1
ε	48.1	49.5	50.00	45.6	47.4	47.8	47.2	46.2	47.7	56.1	47.9	48.2	25.00

Recoil mass ZH -> eeH

I forgot to include Barbar events



ε ~ 24.3%

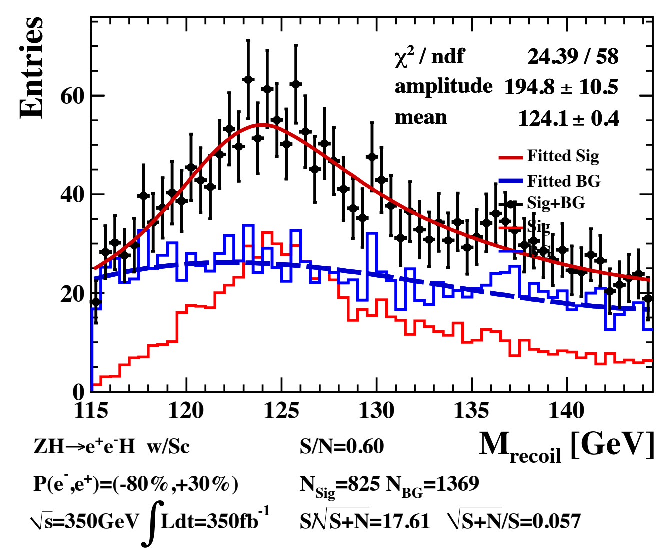
Δm ~ 0.33GeV

σ_M/M ~ 3.02%

$\Delta\sigma_{HZ}/\sigma_{HZ}$ ~ 5.4%

Toy MC (ampli)

$\Delta\sigma_{HZ}/\sigma_{HZ}$ ~5.5%



ε ~ 23.1%

Δm ~ 0.39GeV

σ_M/M ~ 3.16%

$\Delta\sigma_{HZ}/\sigma_{HZ}$ ~ 5.7%

Toy MC (ampli)

$\Delta\sigma_{HZ}/\sigma_{HZ}$ ~6.0%

model independence H ➡

21.2 ~ 30.2 %

except low statistics channel

H→	bb	cc	ss	ww llll	ww qqll	ww qqqq	zz llll	zz qqll	zz qqqq	γγ	gg	ττ	μμ
befo	12156	597	8	547	2219	2276	45	264	312	111	1452	1692	4
aft	3422	173	1	152	595	638	9	56	83	27	439	470	1
ε	28.2	28.9	12.5	27.8	26.8	28.0	20.0	21.2	26.6	24.3	30.2	27.8	25.0

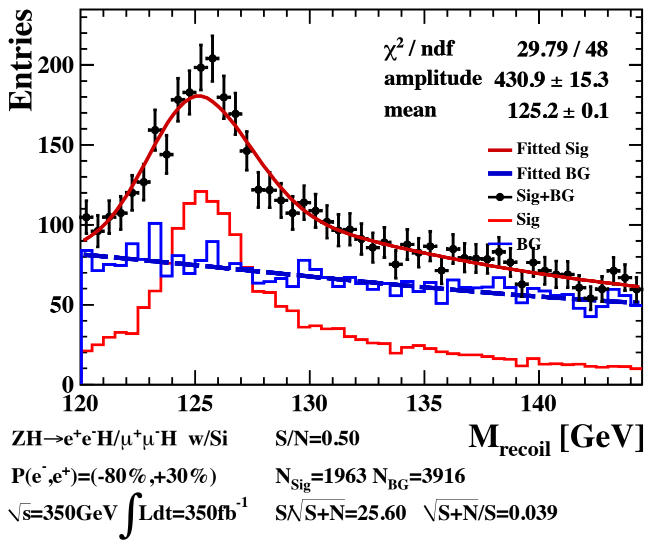
21.6 ~ 29.3 %

except low statistics channel

H→	bb	cc	ss	ww llll	ww qqll	ww qqqq	zz llll	zz qqll	zz qqqq	γγ	gg	ττ	μμ
befo	11779	585	8	527	2159	2202	46	264	300	106	1403	1664	4
aft	3251	167	1	144	559	603	8	57	88	28	400	453	1
ε	27.6	28.5	12.5	27.3	25.9	27.4	17.4	21.6	29.3	26.4	28.5	27.2	25.0

Recoil mass combine

I forgot to include Barbar events

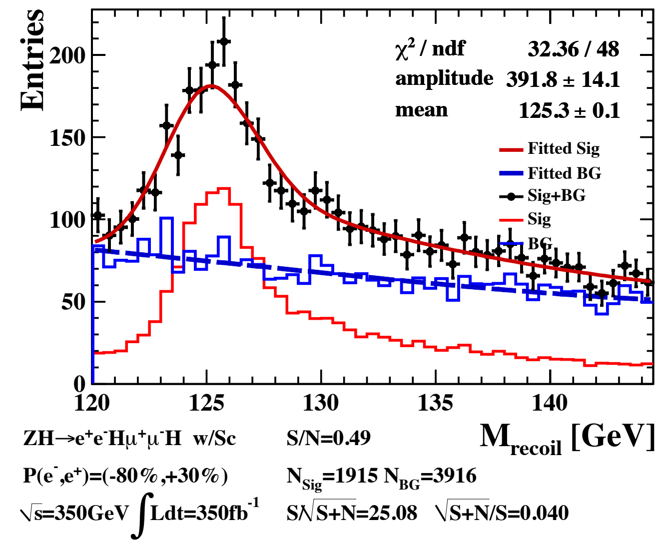


Δm ~ 0.13GeV

σ_M/M ~ 1.83%

$\Delta\sigma_{HZ}/\sigma_{HZ}$ ~ 3.9%

Toy MC (ampli)
$\Delta\sigma_{HZ}/\sigma_{HZ}$ ~3.6%



Δm ~ 0.13GeV

σ_M/M ~ 1.65%

$\Delta\sigma_{HZ}/\sigma_{HZ}$ ~ 4.0%

Toy MC (ampli)
$\Delta\sigma_{HZ}/\sigma_{HZ}$ ~3.7%

Today’s summary & Next step

- For now, there is not remarkable difference with lepton channel analysis.
- Try more detailed analysis 250GeV, 350GeV, 500GeV. (…)
- Try to analyze qq channel. (while keeping model independence)

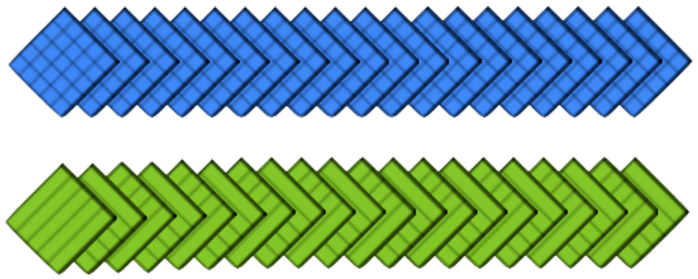
Back up Slides

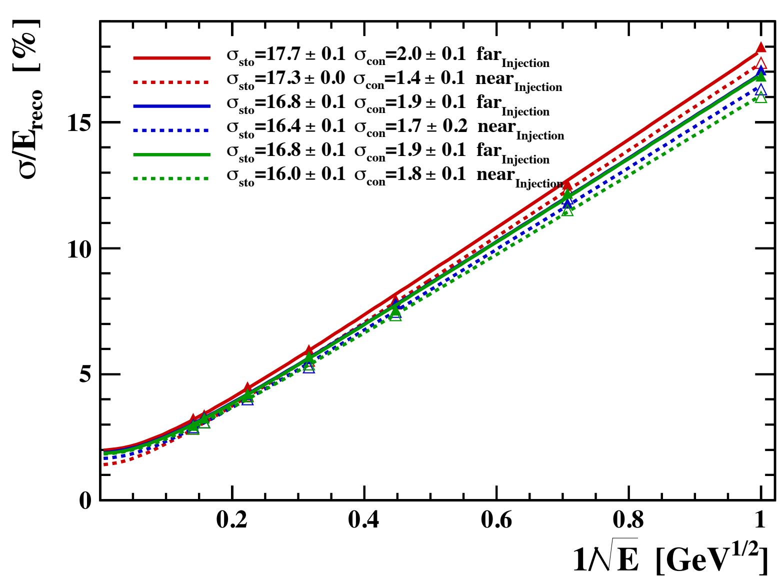
Tuning of SiECAL and ScECAL

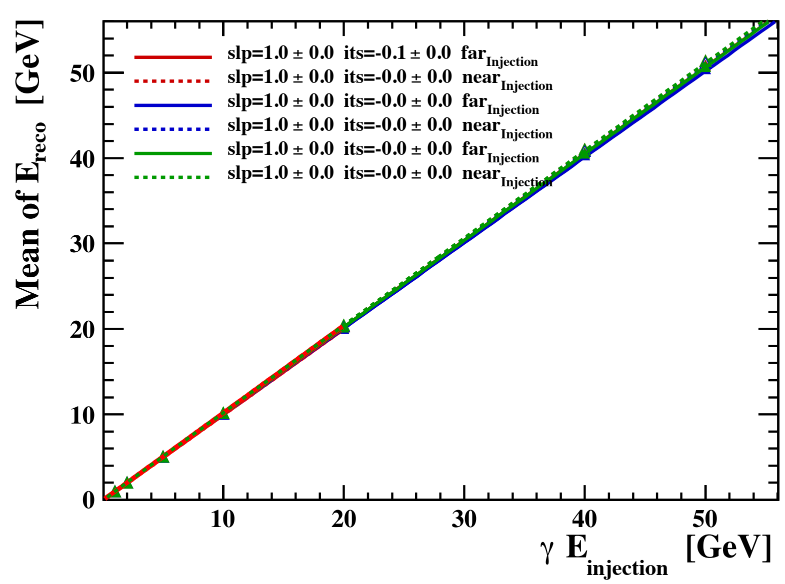
- Linearity

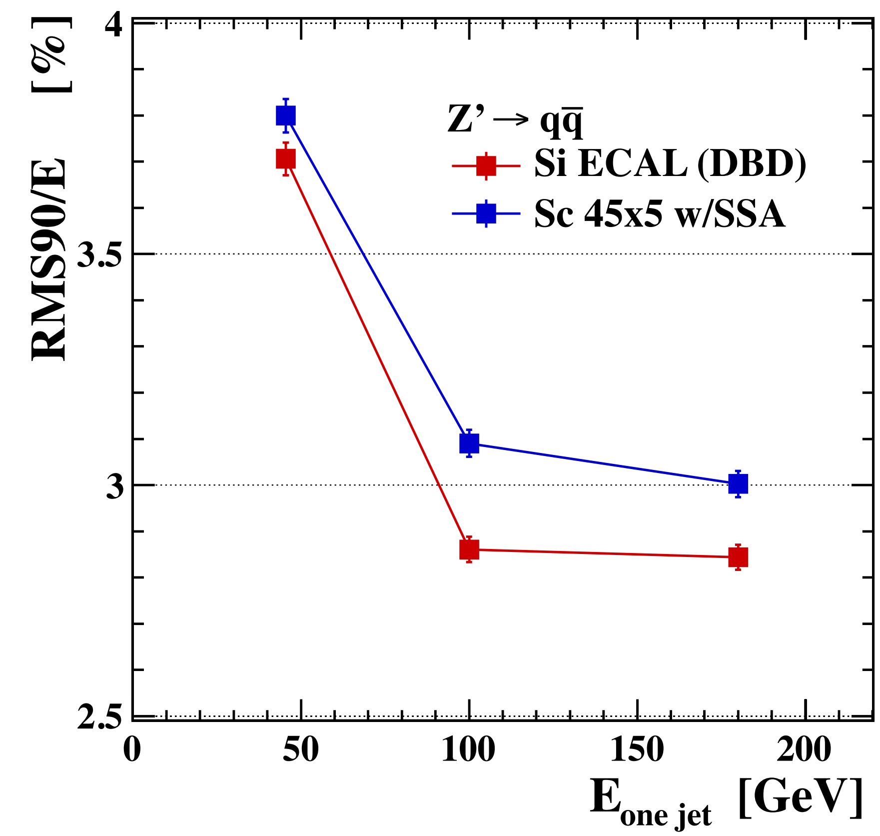
- Energy resolution

- JER





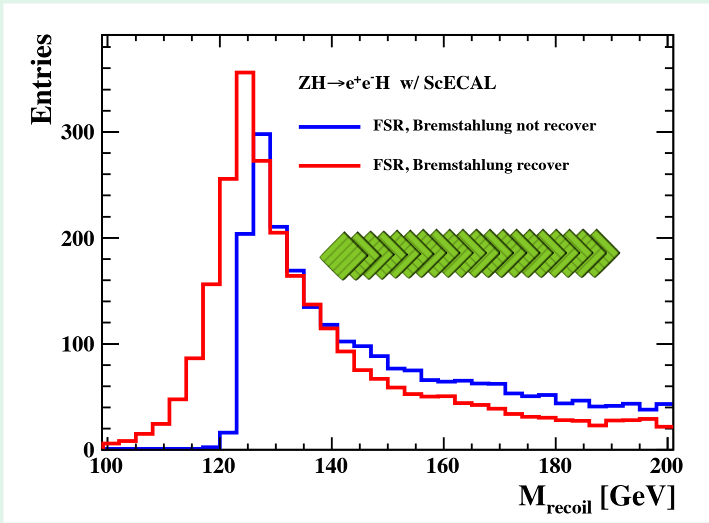




Gamma recovery [FSR, Bremstahlung]

cosθ > 0.9997

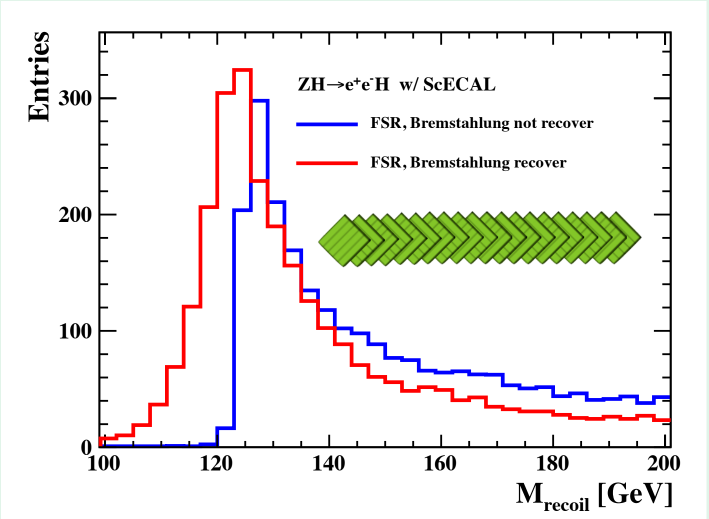
recoil peak ~ 124.9



recoil peak ~ 124.8

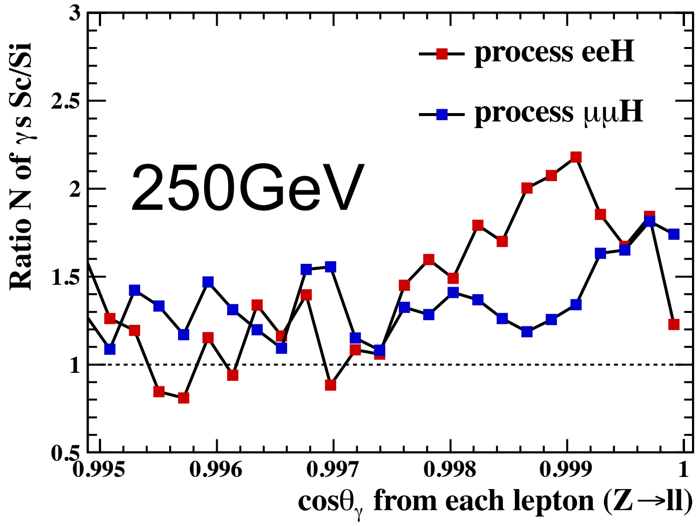
cosθ > 0.9990

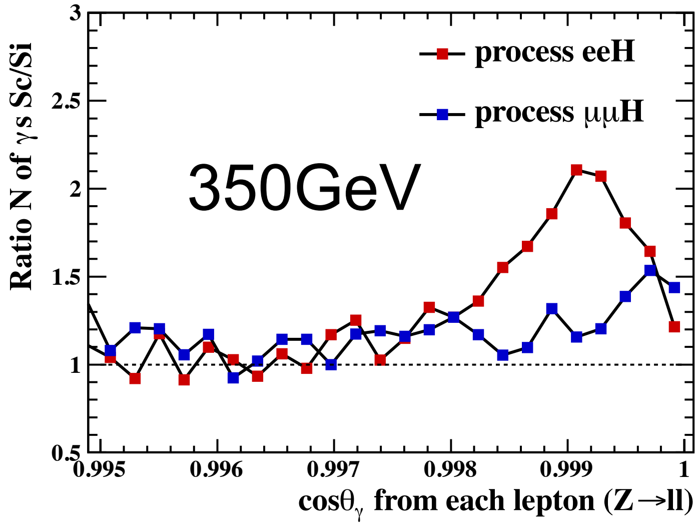
recoil peak ~ 124.4

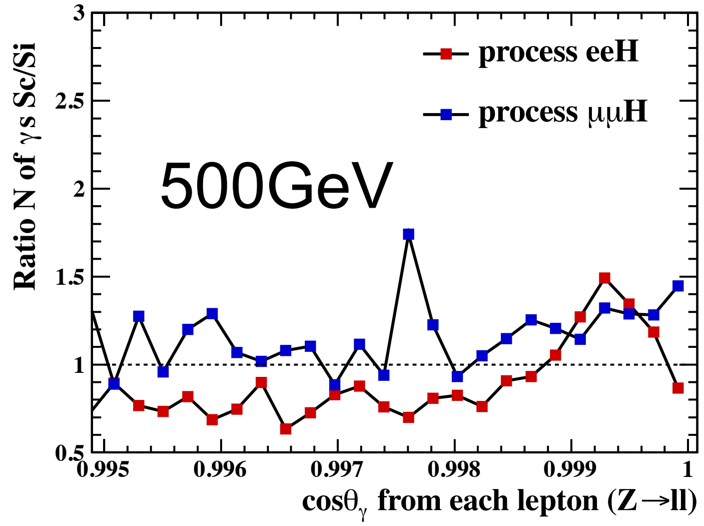


recoil peak ~ 123.8

- gamma is Two times more at around 0.999







Summary of Lepton Identification

- Preconditions : Track exists.

  and cut parameters :

track_P >12GeV	e-ID	μ-ID
hcal_E / allcal_E	<0.95	<0.95
ecal_E / hcal_E	3<	<8
mucal_E / hcal_E	<0.03	0.05<
ecal_E / allcal_E	0.85<	<0.5
allcal_E div track_P	0.7<, <1.25	<0.5

- For 250GeV eeH/mmH signal events.

Si	e-ID	μ-ID
TRUE	50181	51567
id	49673	51880
true&&id	49304	51536
purity	98.25	99.94
efficiency	99.25	99.34

Sc w/ssa	e-ID	μ-ID
TRUE	49405	51627
id	49631	51915
true&&id	48707	51567
purity	98.59	99.88
efficiency	98.14	99.33

- For 350GeV eeH/mmH signal events.

Si	e-ID	μ-ID
TRUE	50807	51987
id	50032	52346
true&&id	49409	51917
purity	97.25	99.87
efficiency	98.75	99.18

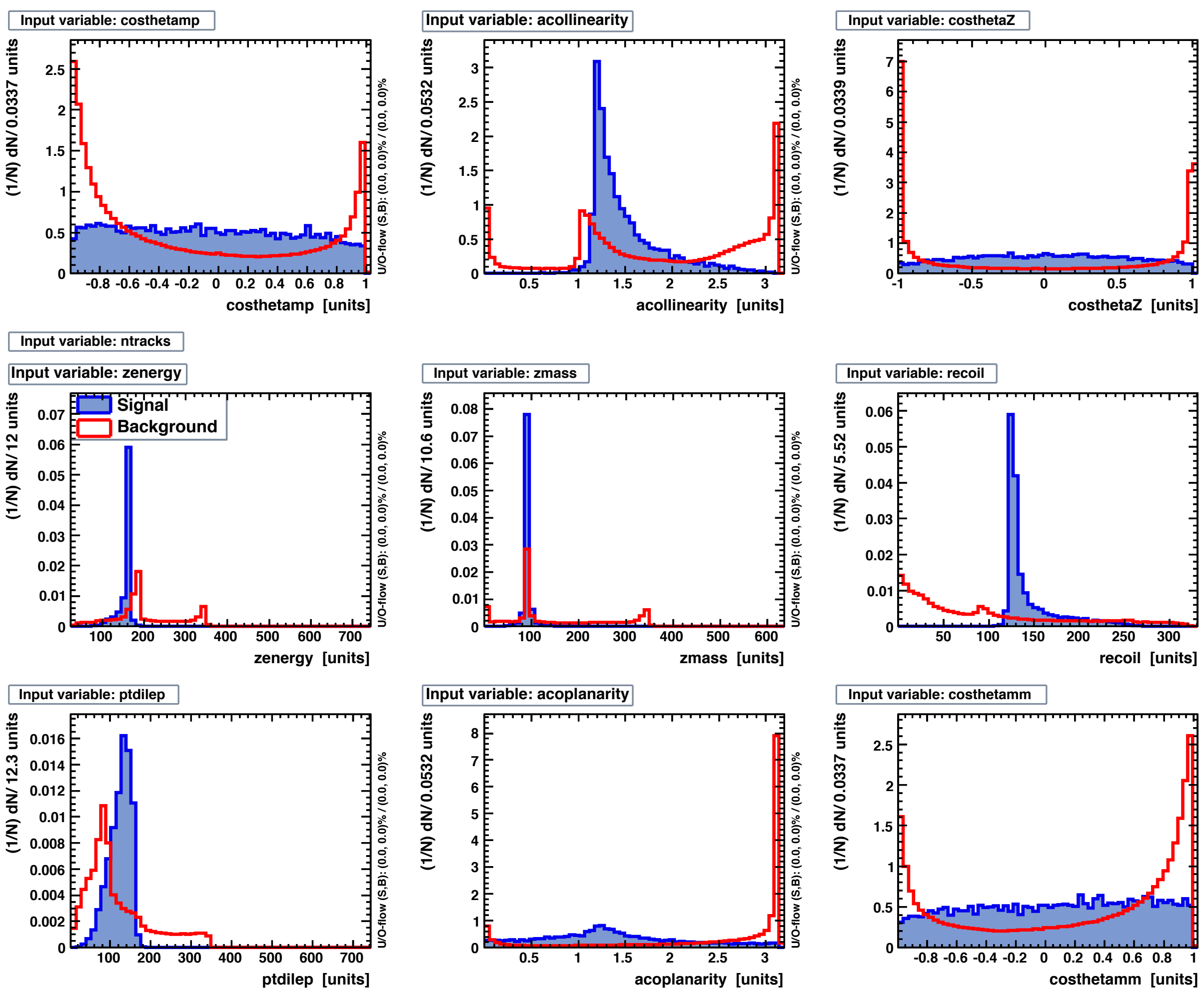
Sc w/ssa	e-ID	μ-ID
TRUE	50117	52337
id	49822	52027
true&&id	48691	51950
purity	97.73	99.85
efficiency	97.15	99.26

- For 500GeV eeH/mmH signal events.

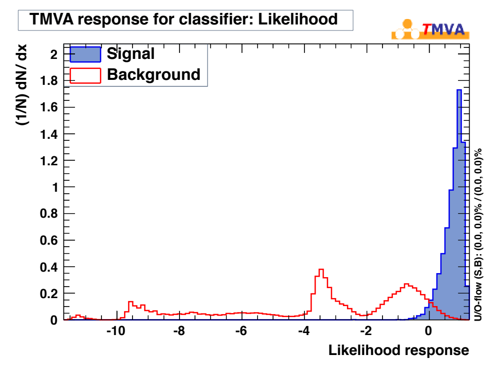
Si	e-ID	μ-ID
TRUE	46267	52429
id	45651	52815
true&&id	44635	52282
purity	96.47	99.72
efficiency	97.78	98.99

Sc w/ssa	e-ID	μ-ID
TRUE	47878	52476
id	48548	52836
true&&id	46407	52308
purity	96.93	99.68
efficiency	95.59	99.00

Likelihood

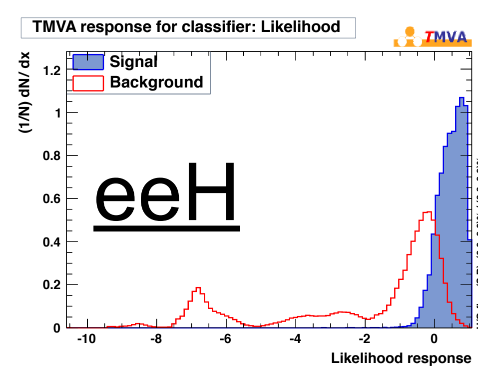


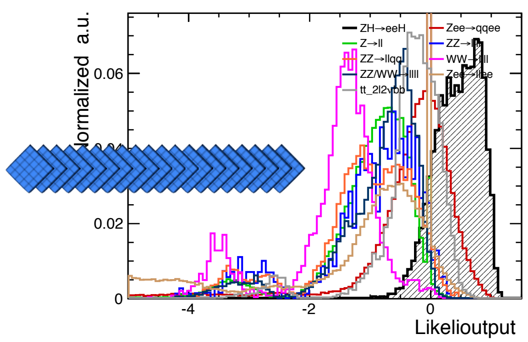
mmH

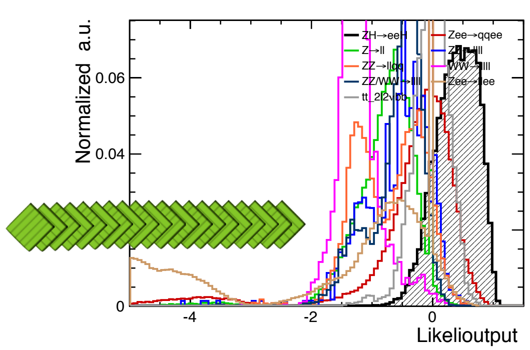


Likeli_out > 0.65

eeH

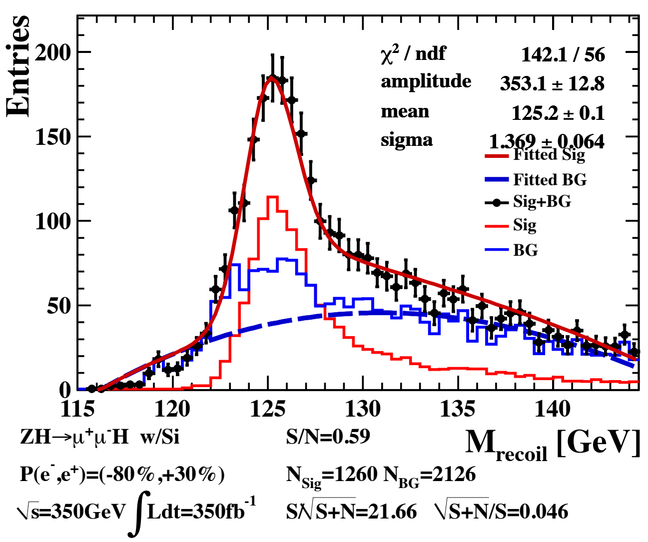






Likeli_out > 0.68

Recoil mass ZH -> mmH @ 350 GeV (-0.8, +0.3)

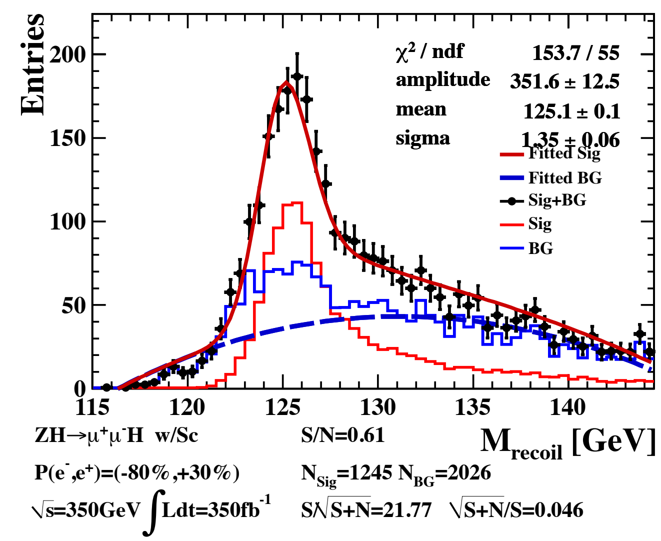


ε ~ 52.7%

Δm ~ 0.08GeV

σM/M ~ 1.09%

ΔσHZ/σHZ ~ 4.6%



ε ~ 52.1%

Δm ~ 0.08GeV

σM/M ~ 1.08%

ΔσHZ/σHZ ~ 4.6%

model independence H ➡

51.4 ~ 57.2 %

except low statistics channel

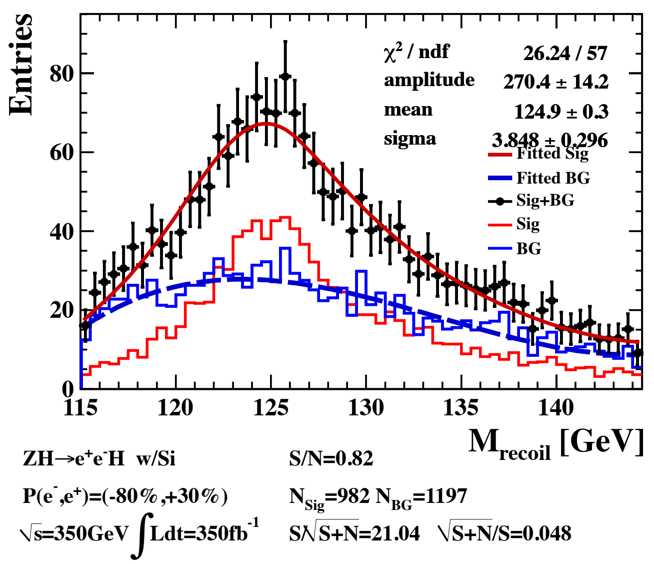
H➡	bb	cc	ss	ww llll	ww qqll	ww qqqq	zz llll	zz qqll	zz qqqq	γγ	gg	ττ	μμ
befo	13467	691	8	589	2339	2513	72	301	306	106	1615	1790	4
aft	7469	395	6	303	1289	1413	35	165	173	58	912	985	1
ε	55.4	57.2	75.0	51.4	55.1	56.2	48.6	54.8	56.5	54.7	56.5	55.0	25.0

51.1 ~ 55.8 %

except low statistics channel

H→	bb	cc	ss	ww llll	ww qqll	ww qqqq	zz llll	zz qqll	zz qqqq	γγ	gg	ττ	μμ
befo	13451	691	8	590	2333	2529	72	299	304	107	1627	1788	4
aft	7354	386	5	301	1280	1412	37	159	170	60	894	971	2
ε	54.7	55.8	62.5	51.1	54.8	55.8	51.4	53.2	55.9	56.1	54.9	54.3	50.0

Recoil mass ZH -> eeH @ 350 GeV (-0.8, +0.3)

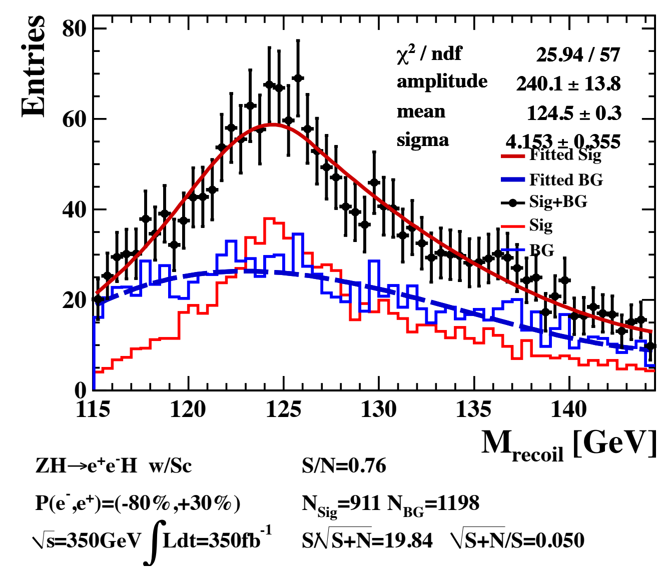


ε ~ 27.4%

Δm ~ 0.27GeV

σ_M/M ~ 3.08%

$\Delta\sigma_{HZ}/\sigma_{HZ}$ ~ 4.8%



ε ~ 25.4%

Δm ~ 0.33GeV

σ_M/M ~ 3.33%

$\Delta\sigma_{HZ}/\sigma_{HZ}$ ~ 5.0%

model independence H ➡

28.4 ~ 34.8 %

except low statistics channel

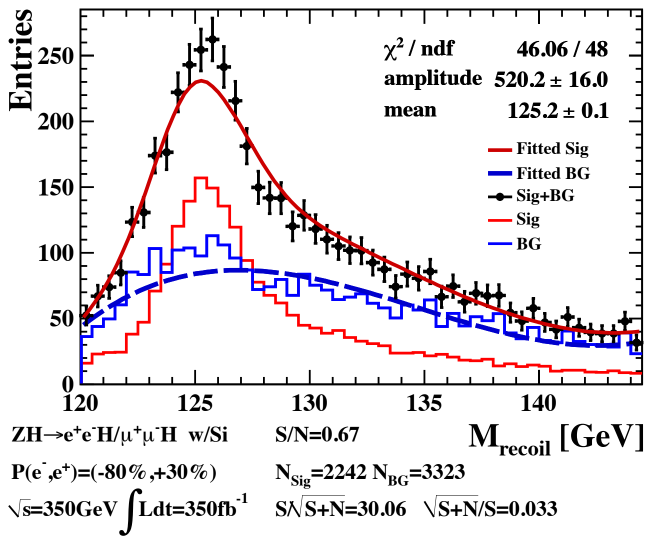
H→	bb	cc	ss	ww llll	ww qqll	ww qqqq	zz llll	zz qqll	zz qqqq	γγ	gg	ττ	μμ
befo	12156	597	8	547	2219	2276	45	264	312	111	1452	1692	4
aft	3864	208	2	164	673	705	10	75	107	34	489	508	1
ε	31.8	34.8	25.0	29.9	30.3	30.9	22.2	28.4	34.3	30.6	33.7	30.0	25.0

25.0 ~ 34.6 %

except low statistics channel

H→	bb	cc	ss	ww llll	ww qqll	ww qqqq	zz llll	zz qqll	zz qqqq	γγ	gg	ττ	μμ
befo	11779	585	8	527	2159	2202	46	264	300	106	1403	1664	4
aft	3584	199	2	156	613	664	10	66	104	36	427	501	1
ε	30.4	34.0	25.0	29.6	28.4	30.1	21.7	25.0	34.6	33.9	30.4	30.1	25.0

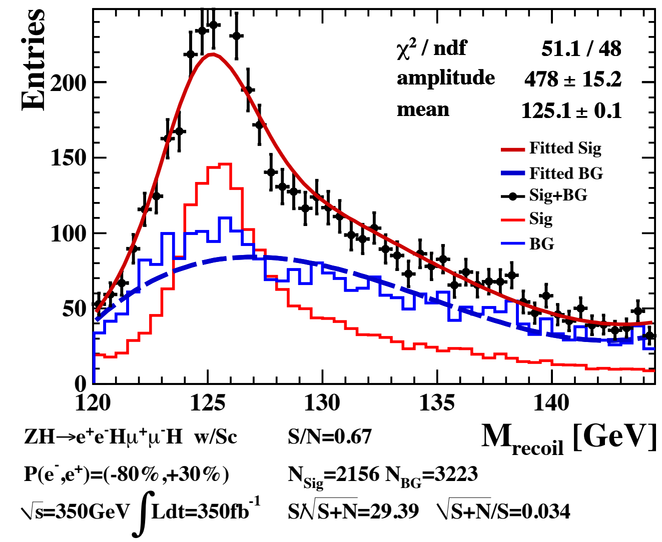
Recoil mass combine (-0.8, +0.3)



$\Delta m \sim 0.09$GeV

$\sigma_M/M \sim 1.60\%$

$\Delta\sigma_{HZ}/\sigma_{HZ} \sim 3.3\%$



$\Delta m \sim 0.09$GeV

$\sigma_M/M \sim 1.57\%$

$\Delta\sigma_{HZ}/\sigma_{HZ} \sim 3.4\%$

Back up Slides

ZH -> llH @ 250GeV, 500GeV (-0.8, +0.3)

Summary of Cross Section [Signal] (-0.8, +0.3)

- For 250GeV (250fb^-1)

[E250_e1L0.8_E1R0.3_zh_eeh]

xsec = 10.9875
xsec*lumi = 2746.87

[E250_e1L0.8_E1R0.3_zh_mmh]

xsec = 10.4773
xsec*lumi = 2619.33

- For 350GeV (350fb^-1)

[E350_e1L0.8_E1R0.3_zh_eeh]

xsec = 10.2267
xsec*lumi = 3579.35

[E350_e1L0.8_E1R0.3_zh_mmh]

xsec = 6.82255
xsec*lumi = 2387.89

- For 500GeV (500fb^-1)

[E500_e1L0.8_E1R0.3_zh_eeh]

xsec = 11.4046
xsec*lumi = 5702.29

[E500_e1L0.8_E1R0.3_zh_mmh]

xsec = 3.3046
xsec*lumi = 1652.3

Summary of Cross Section [BG] (-0.8, +0.3)

- For 250GeV (250fb^-1)

[2f_Z_bhabhag]
xsec = 15640.8
xsec*lumi = 3.91021e+06

[2f_Z_leptonic]
xsec = 12993.9
xsec*lumi = 3.24847e+06

[4f_ZZ_leptonic]
xsec = 95.8895
xsec*lumi = 23972.4

[4f_ZZ_semileptonic]
xsec = 856.927
xsec*lumi = 214232

[4f_WW_leptonic]
xsec = 915.577
xsec*lumi = 228894

[4f_WW_semileptonic]
xsec = 10992.9
xsec*lumi = 2.74823e+06

[4f_singleZee_leptonic]
xsec = 669.874
xsec*lumi = 167469

[4f_singleZee_semileptonic]
xsec = 279.625
xsec*lumi = 69906.3

- For 350GeV (350fb^-1)

[2f_Z_bhabhag]
xsec = 17173.2
xsec*lumi = 6.0106e+06

[2f_Z_leptonic]
xsec = 6685.77
xsec*lumi = 2.34002e+06

[4f_ZZ_leptonic]
xsec = 58.9545
xsec*lumi = 20634.1

[4f_ZZ_semileptonic]
xsec = 564.825
xsec*lumi = 197689

[4f_WW_leptonic]
xsec = 679.256
xsec*lumi = 237740

[4f_WW_semileptonic]
xsec = 8155.94
xsec*lumi = 2.85458e+06

[4f_singleZee_leptonic]
xsec = 732.373
xsec*lumi = 256330

[4f_singleZee_semileptonic]
xsec = 309.998
xsec*lumi = 108499

- For 500GeV (500fb^-1)

[2f_Z_bhabhag]
xsec = 2250.44
xsec*lumi = 1.12522e+06

[2f_Z_leptonic]
xsec = 3387.72
xsec*lumi = 1.69386e+06

[4f_ZZ_leptonic]
xsec = 36.4021
xsec*lumi = 18201

[4f_ZZ_semileptonic]
xsec = 366.106
xsec*lumi = 183053

[4f_WW_leptonic]
xsec = 462.713
xsec*lumi = 231357

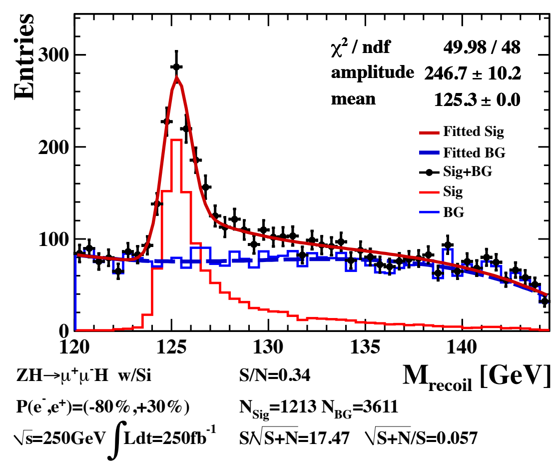
[4f_WW_semileptonic]
xsec = 5571.64
xsec*lumi = 2.78582e+06

[4f_singleZee_leptonic]
xsec = 4494.54
xsec*lumi = 2.24727e+06

[4f_singleZee_semileptonic]
xsec = 1207.69
xsec*lumi = 603845

ZH -> llH @ 250 GeV (e-,e+)=(-80%,+30%)

mmH

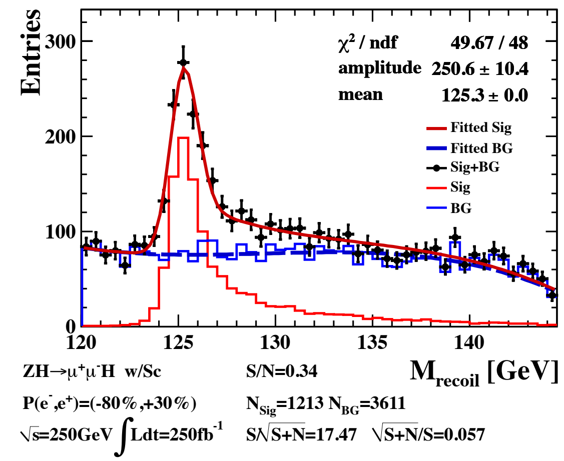


ε ~ 46.3%

Δm ~ 0.047GeV

σM/M ~ 0.55%

ΔσHZ/σHZ ~ 5.7%



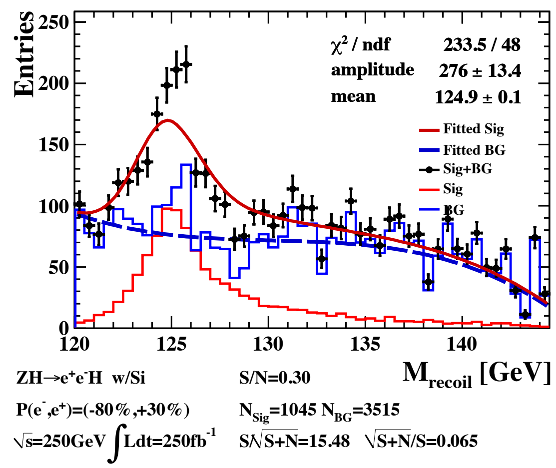
ε ~ 46.3%

Δm ~ 0.048GeV

σM/M ~ 0.57%

ΔσHZ/σHZ ~ 5.7%

eeH

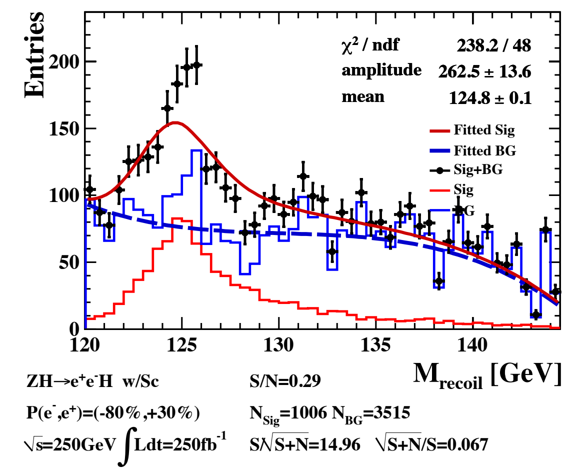


ε ~ 38.05%

Δm ~ 0.10GeV

σM/M ~ 1.34%

ΔσHZ/σHZ ~ 6.5%



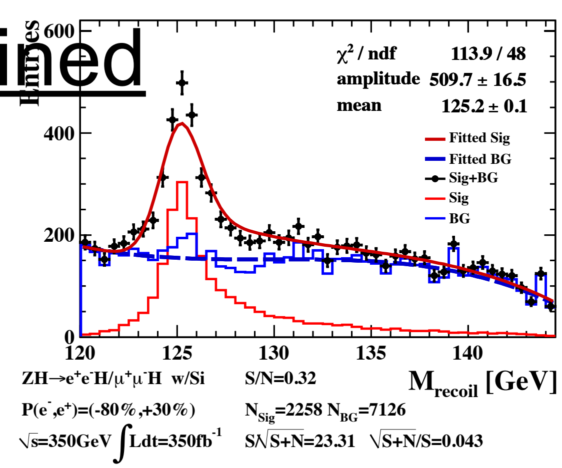
ε ~ 36.67%

Δm ~ 0.13GeV

σM/M ~ 1.52%

ΔσHZ/σHZ ~ 6.7%

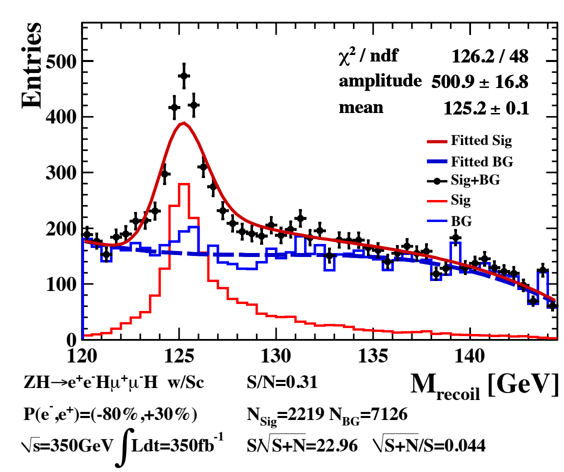
combined



Δm ~ 0.051GeV

σM/M ~ 0.87%

ΔσHZ/σHZ ~ 4.3%



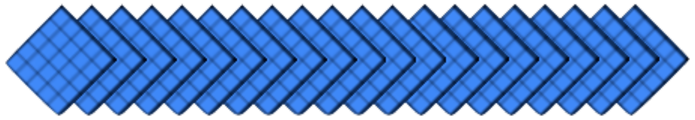
Δm ~ 0.058GeV

σM/M ~ 0.96%

ΔσHZ/σHZ ~ 4.4%

ZH -> llH @ 250 GeV (e-,e+)=(-80%,+30%)

mmH



decay	bb,	cc,	ss,	gamgam,	gluglu,	tautau,	mumu
effic	48.7,	48.1,	50,	49.6,	49.0,	47.6,	44.44

decay	WW_llll,	WW_qqll,	WW_qqqq,	ZZ_llll,	ZZ_qqll,	ZZ_qqqq
effic	49.4,	46.71,	49.43,	54.7,	45.84,	53.3546

decay	bb,	cc,	ss,	gamgam,	gluglu,	tautau,	mumu
effic	48.6694,	48.3,	50,	48.69,	48.8184,	48.1779,	44.4444

decay	WW_llll,	WW_qqll,	WW_qqqq,	ZZ_llll,	ZZ_qqll,	ZZ_qqqq
effic	48.7562,	47.0614,	48.9895,	52.8302,	46.4029,	53.7217

eeH

decay	bb,	cc,	ss,	gamgam,	gluglu,	tautau,	mumu
effic	43.98,	40.13,	58.3,	32.381,	44.6453,	41.3507,	0

decay	WW_llll,	WW_qqll,	WW_qqqq,	ZZ_llll,	ZZ_qqll,	ZZ_qqqq
effic	39.823,	43.2115,	43.6087,	54.2373,	43.4783,	45.8484

decay	bb,	cc,	ss,	gamgam,	gluglu,	tautau,	mumu
effic	43.36,	41.39,	45.45,	30.9091,	43.5185,	41.5094,	0

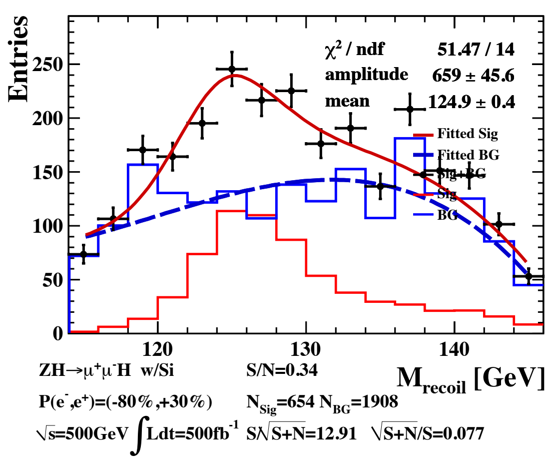
decay	WW_llll,	WW_qqll,	WW_qqqq,	ZZ_llll,	ZZ_qqll,	ZZ_qqqq
effic	40.1079,	42.0544,	42.6193,	50,	41.7391,	47.2119

These are all cut analysis.
Cut has not optimized yet.

But for now, No notable difference between Si and Sc

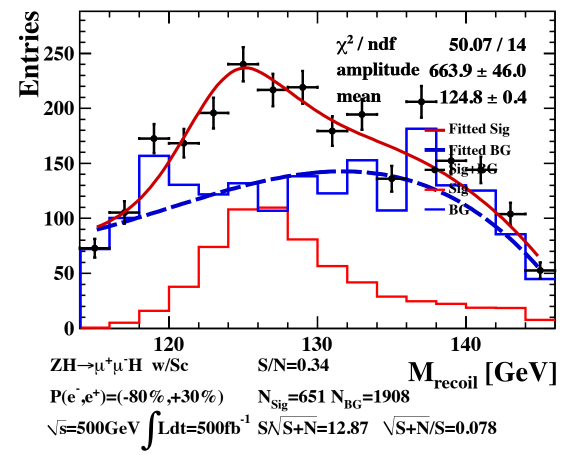
ZH -> llH @ 500 GeV (e-,e+)=(-80%,+30%)

mmH



ε ~ 39.5%

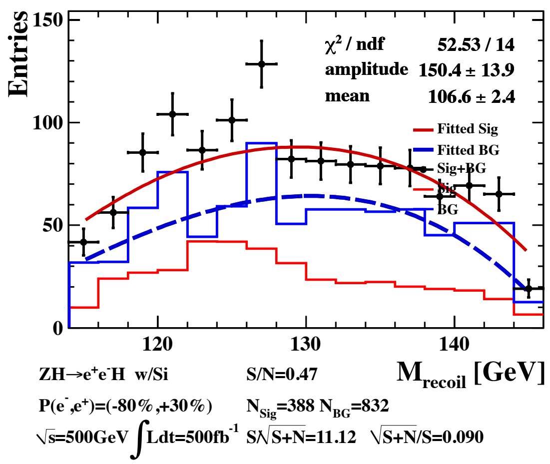
ΔσHZ/σHZ ~ 7.7%



ε ~ 39.4%

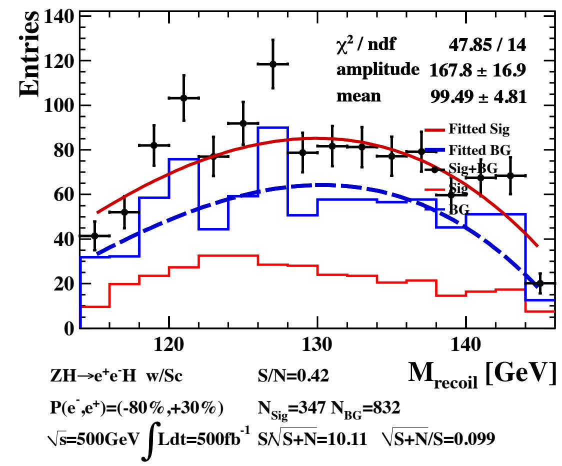
ΔσHZ/σHZ ~ 7.8%

eeH



ε ~ 6.8%

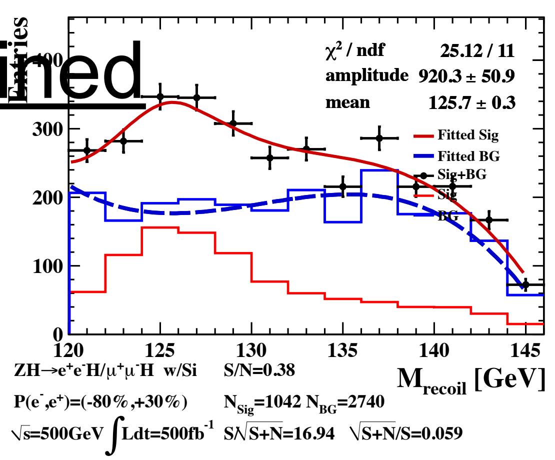
ΔσHZ/σHZ ~ 9.0%



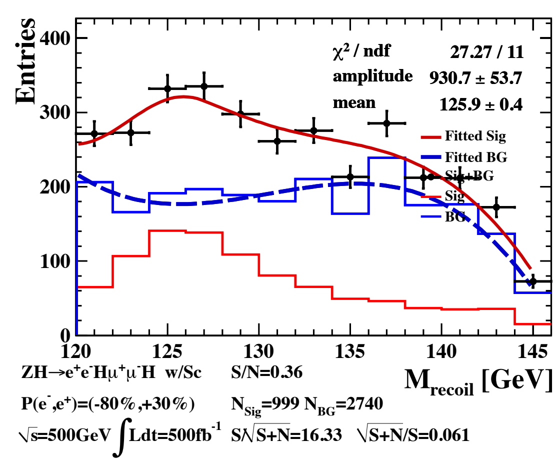
ε ~ 6.0%

ΔσHZ/σHZ ~ 9.9%

combined



ΔσHZ/σHZ ~ 5.9%



ΔσHZ/σHZ ~ 6.1%

ZH -> llH @ 500 GeV (e-,e+)=(-80%,+30%)

mmH

eeH

All cut analysis.
Cut is not optimized.

For now, No notable difference between Si and Sc

Back up Slides

ZH -> qqH @ 250GeV, 350GeV, 500GeV (-0.8, +0.3)

Summary of Cross Section (-0.8, +0.3)

- For 250GeV (250fb^-1)

[E250_e1L0_8_E1R0_3_zh_qqh]
xsec = 212.234
xsec*lumi = 53058.5

[4f_WW_semileptonic]
xsec = 10992.9
xsec*lumi = 2.74823e+06

[4f_ZZ_semileptonic]
xsec = 856.927
xsec*lumi = 214232

[4f_ZZ_hadronic]
xsec = 841.376
xsec*lumi = 210344

[4f_WW_hadronic]
xsec = 8706.23
xsec*lumi = 2.17656e+06

[4f_singleZee_semileptonic]
xsec = 279.625
xsec*lumi = 69906.3

- For 350GeV (350fb^-1)

[E350_e1L0_8_E1R0_3_zh_qqh]
xsec = 142.646
xsec*lumi = 49926

[4f_WW_semileptonic]
xsec = 8155.94
xsec*lumi = 2.85458e+06

[4f_ZZ_semileptonic]
xsec = 564.825
xsec*lumi = 197689

[4f_ZZ_hadronic]
xsec = 600.841
xsec*lumi = 210294

[4f_WW_hadronic]
xsec = 6532.83
xsec*lumi = 2.28649e+06

[4f_singleZee_semileptonic]
xsec = 309.998
xsec*lumi = 108499

[tt-ln4q]
xsec = 76.2609
xsec*lumi = 26691.3

- For 500GeV (500fb^-1)

Analysis flow [Follow M.Thomson flow]

- Basically I follow M.Thomson analysis.

- Force jet-clustering into 3-Jets , 4-Jets and 5-Jets with Durham algorithm at each event.

  3-Jet : select the best pare closest to W mass

  4-Jet : select the best two pairs closest to Z mass & W mass

  5-Jet : select the best two pairs closest to Z mass & W mass

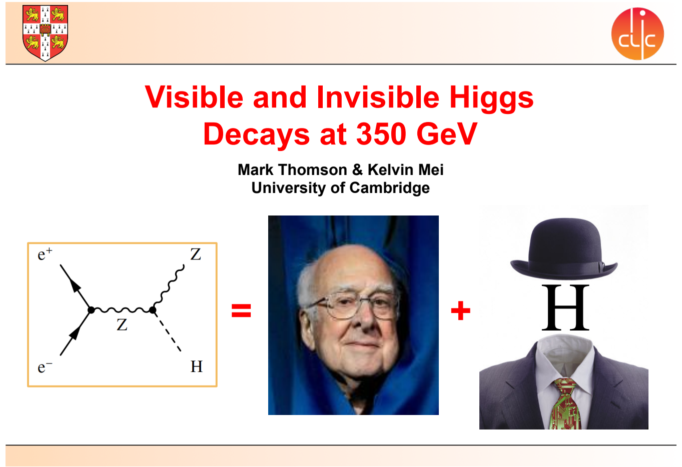
- Default is to treat as 4-jets

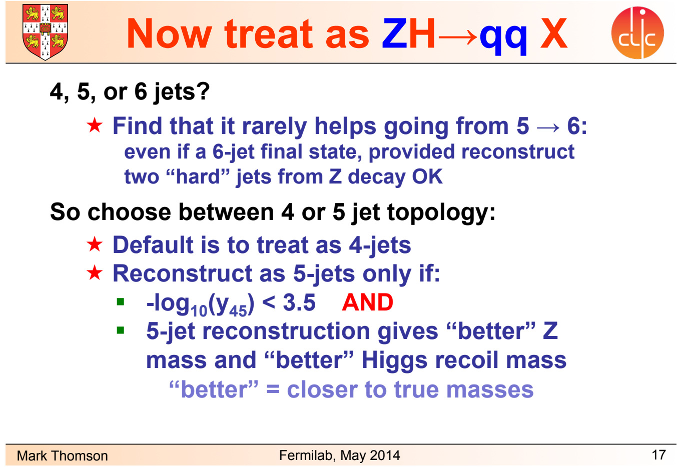
  5-jet reconstruction gives

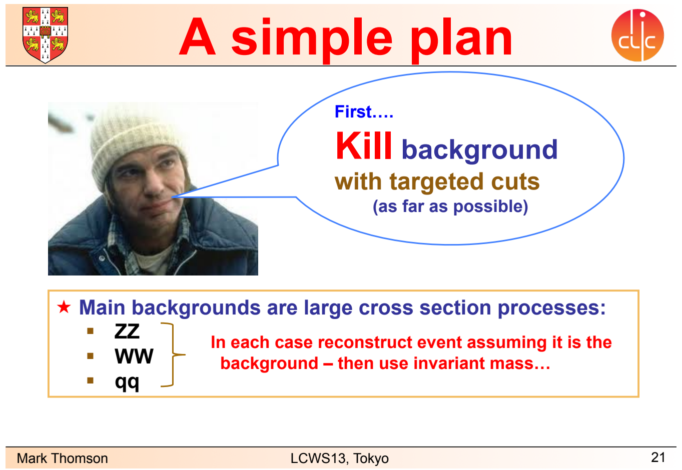
  “better” Z mass and “better” Higgs recoil mass

  ➡ treat as 5-jets

- Then, target cut for BG suppression.



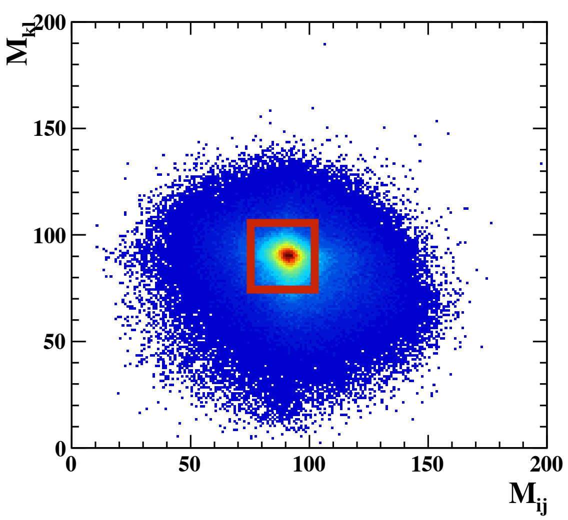




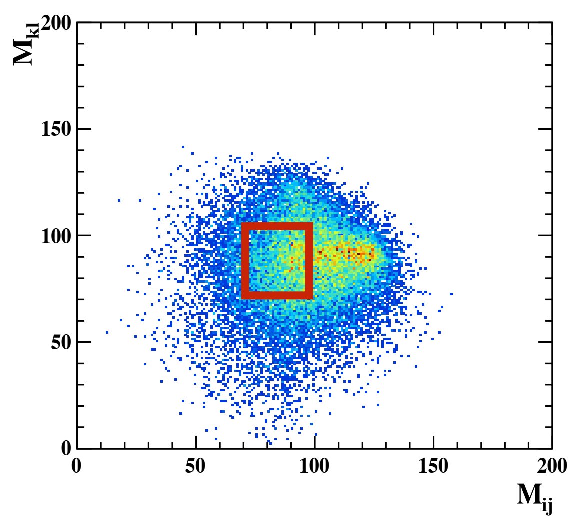
Target cut for BG suppression

- For 250GeV (250fb^-1) (-0.8, +0.3)

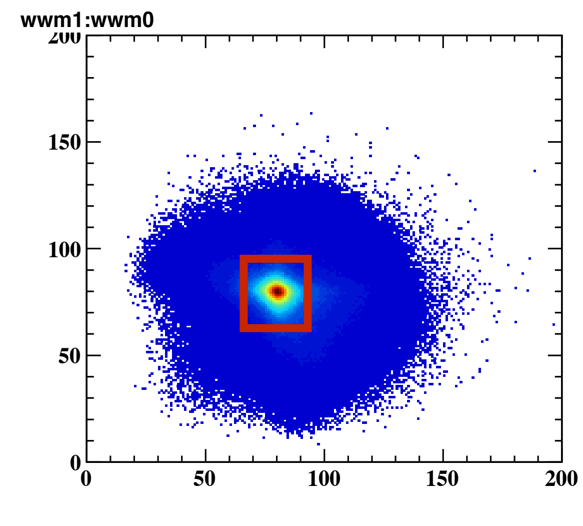
ZZ → qqqq



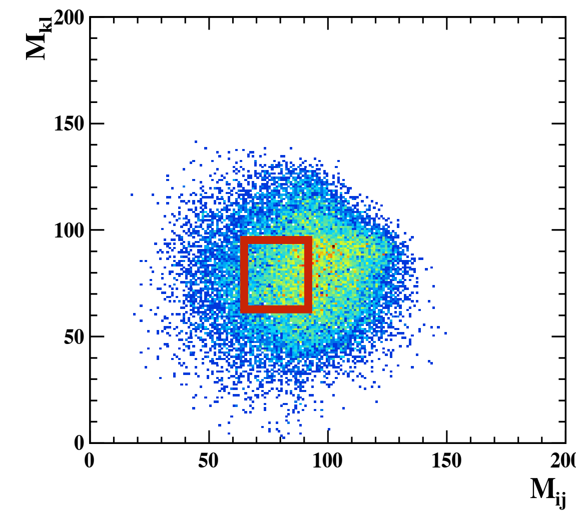
ZH → qqxx



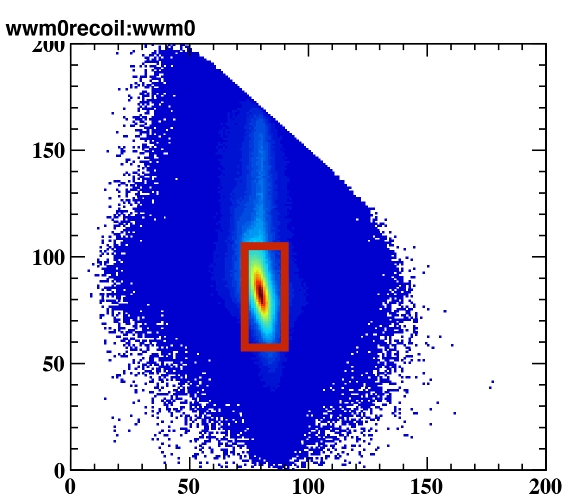
WW→ qqqq

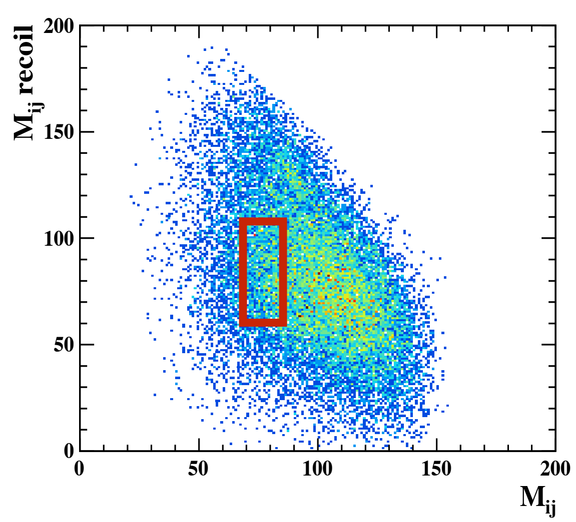


ZH → qqxx



WW→ qqlv





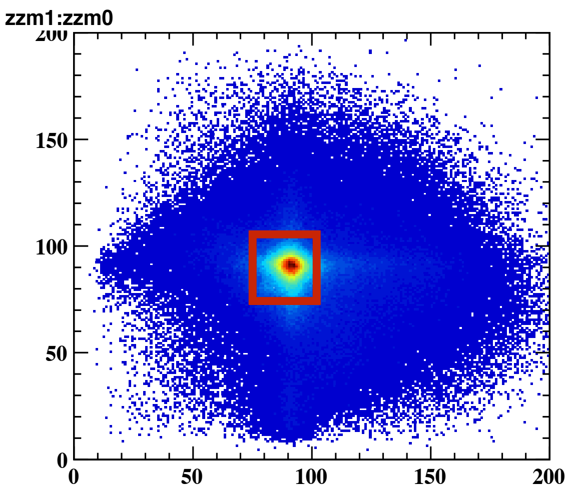
Other cuts

visE < 260
|cosθjet1| <0.95
|cosθjet2| <0.95
-0.8 < |cosθjet12| <0.0
|cosθZ| <0.75
Pt^2_jet1>1200
90< E_z < 130
85 < M_z <105

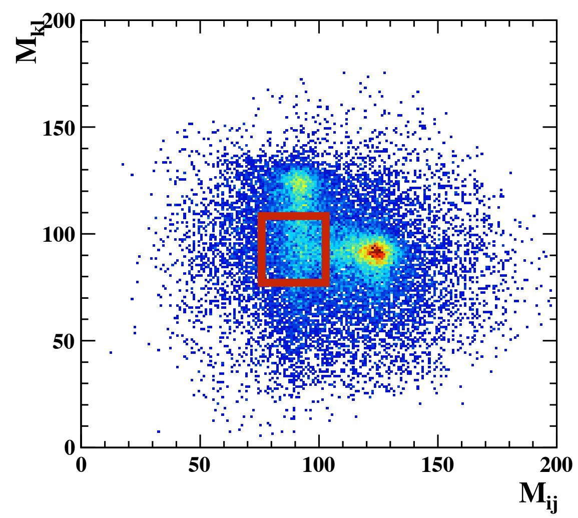
Target cut for BG suppression

- For 350GeV (350fb^-1) (-0.8, +0.3)

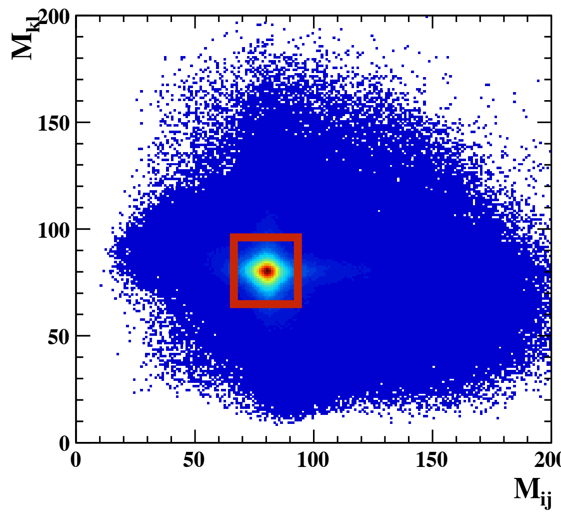
ZZ → qqqq



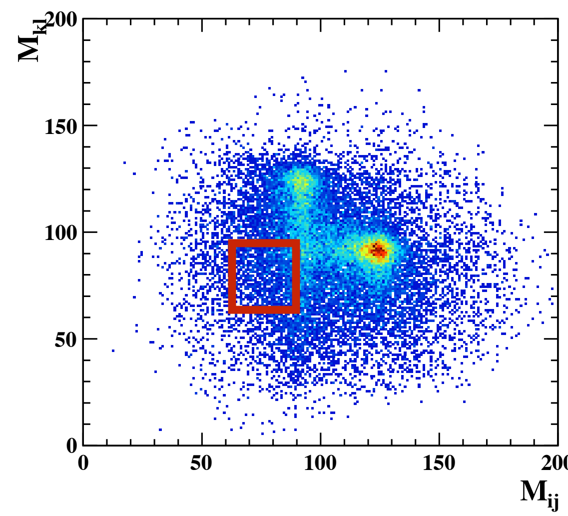
ZH → qqxx



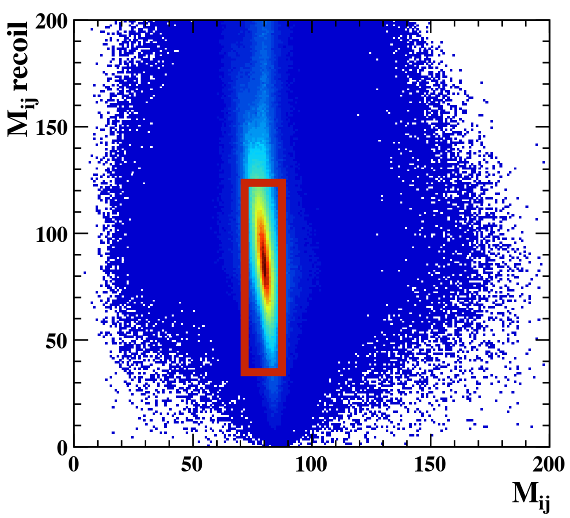
WW→ qqqq

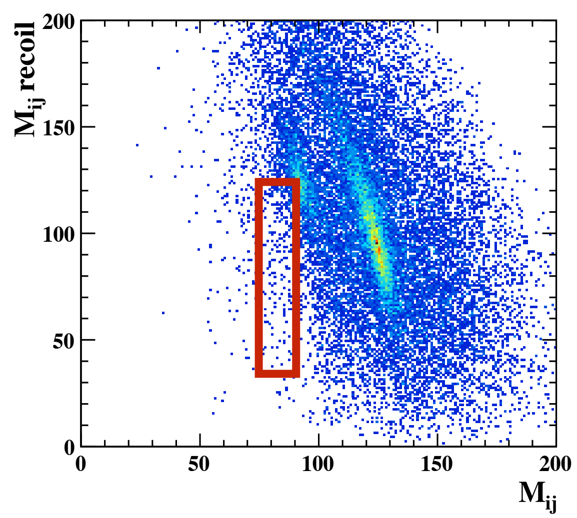


ZH → qqxx



WW→ qqlv





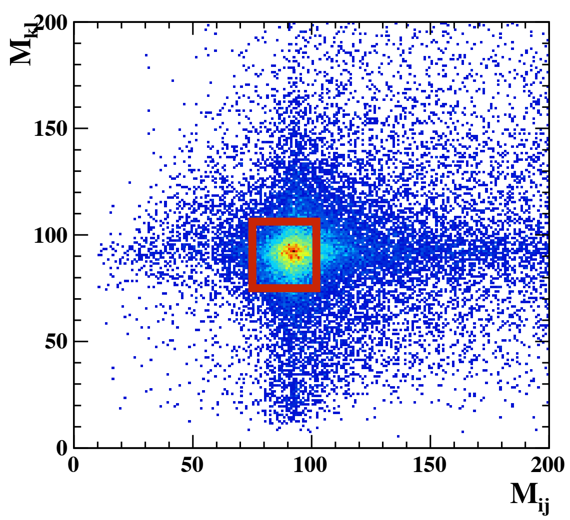
Other cuts

visE < 360
|cosθjet1| <0.9
|cosθjet2| <0.9
-0.8 < |cosθjet12| <0.5
|cosθZ| <0.7
Pt^2_jet1>2500
100< E_z < 180
85 < M_z <105

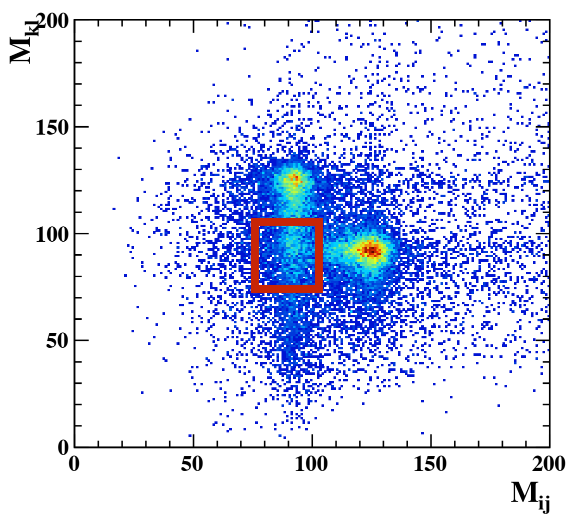
Target cut for BG suppression

- For 500GeV (500fb^-1) (-0.8, +0.3)

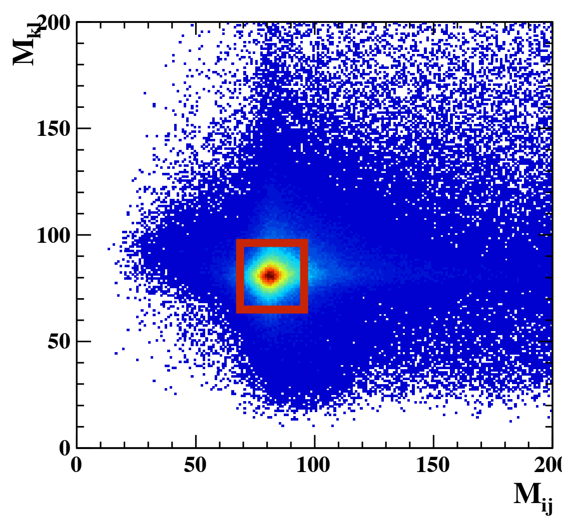
ZZ → qqqq



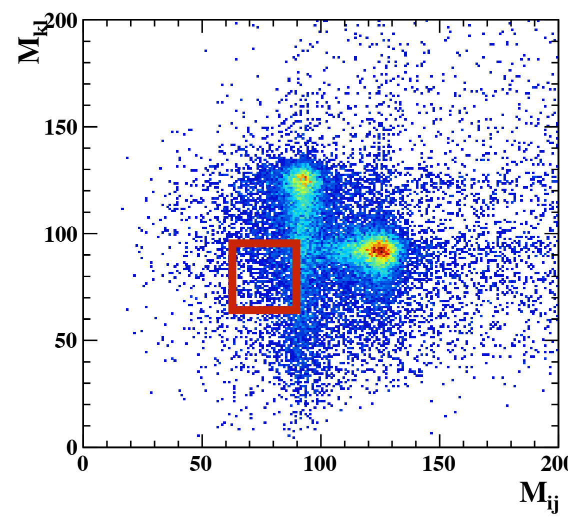
ZH → qqxx



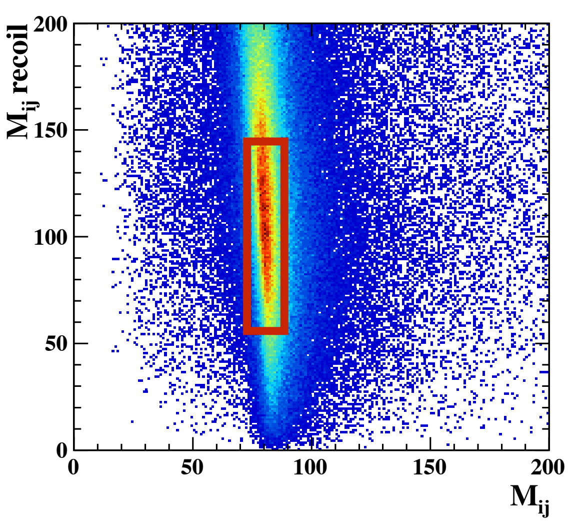
WW→ qqqq

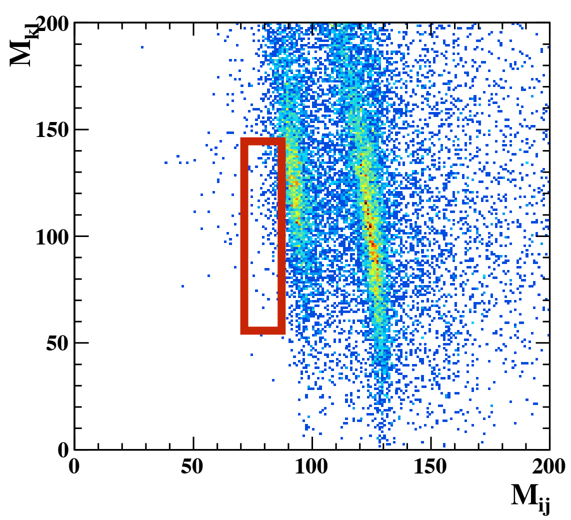


ZH → qqxx



WW→ qqlv

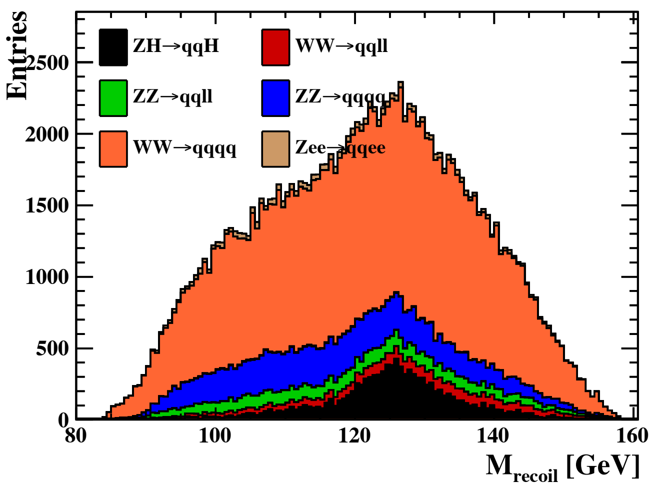




Other cuts

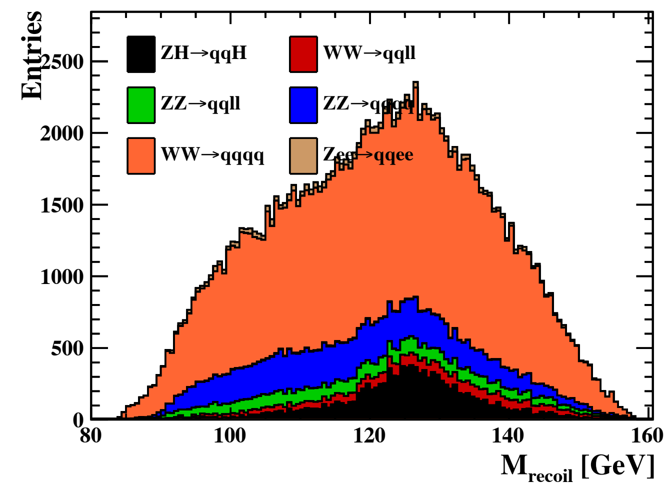
- visE < 510
- |cosθjet1| <0.75
- |cosθjet2| <0.75
- -0.6 < |cosθjet12| <0.78
- |cosθZ| <0.7
- Pt^2_jet1>2500
- 100< E_z < 255
- 85 < M_z <105

Process ZH -> qqH @ 250 GeV (-0.8, +0.3)



ε ~ 21.4%

ΔσHZ/σHZ ~ 3.4%



ε ~ 21.4%

ΔσHZ/σHZ ~ 3.4%

19.2 ~ 26.7 %

except low statistics channel

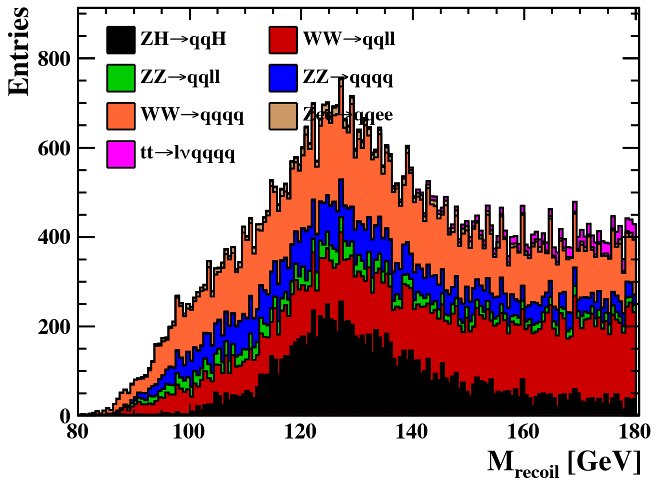
H→	bb	cc	ss	ww llll	ww qqll	ww qqqq	zz llll	zz qqll	zz qqqq	γγ	gg	ττ	μμ
befo	14198	708	8	600	2565	2585	57	262	364	130	1683	1827	12
aft	3020	160	1	160	572	494	9	61	81	29	364	398	2
ε	21.3	22.6	12.5	26.7	22.3	19.2	15.8	23.3	22.0	22.3	21.6	21.8	16.7

19.5 ~ 25.4 %

except low statistics ch

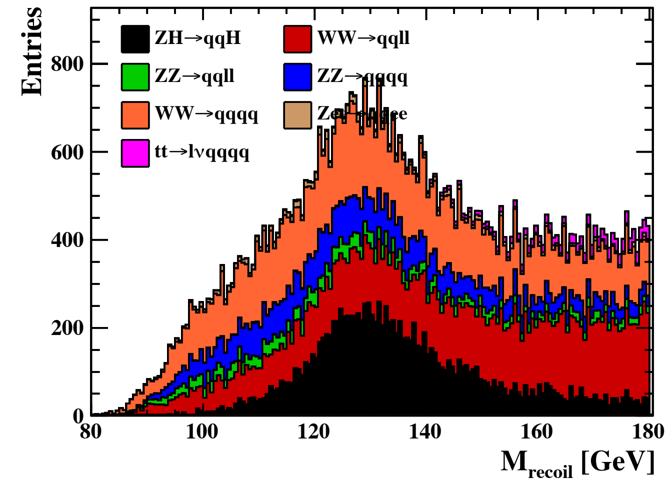
H→	bb	cc	ss	ww llll	ww qqll	ww qqqq	zz llll	zz qqll	zz qqqq	γγ	gg	ττ	μμ
befo	14198	708	8	600	2565	2585	57	262	364	130	1683	1827	12
aft	2905	155	3	136	631	511	10	51	81	33	364	402	1
ε	20.4	21.9	37.5	22.7	24.6	19.8	17.5	19.5	22.3	25.4	21.6	22.0	8.3

Process ZH -> qqH @ 350 GeV (-0.8, +0.3)



ε ~ 27.9%

ΔσHZ/σHZ ~ 2.1%



ε ~ 29.6%

ΔσHZ/σHZ ~ 2.0%

21.1 ~ 29.9 %

except low statistics channel

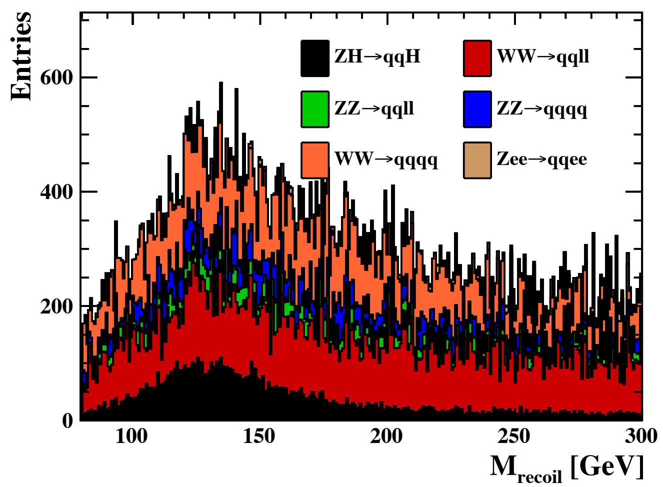
H→	bb	cc	ss	ww llll	ww qqll	ww qqqq	zz llll	zz qqll	zz qqqq	γγ	gg	ττ	μμ
befo	14300	677	7	617	2517	2517	61	289	340	109	1752	1809	5
aft	4276	182	1	182	627	586	10	61	91	24	446	483	1
ε	29.9	26.9	14.3	29.5	25.0	23.3	16.4	21.1	26.7	22.0	25.5	26.7	20.0

19.7 ~ 31.5 %

except low statistics ch

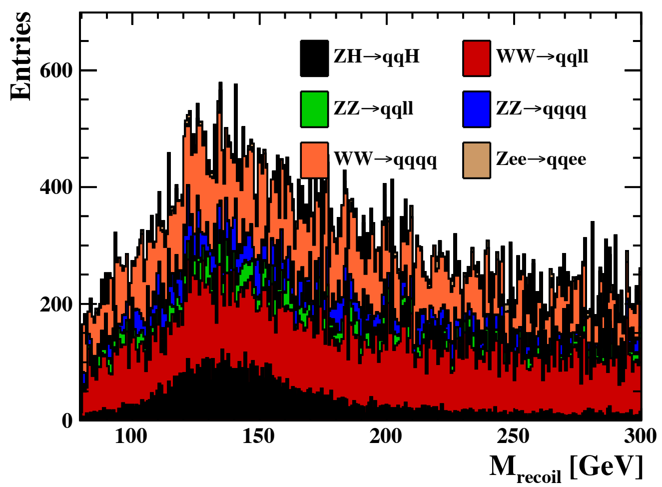
H→	bb	cc	ss	ww llll	ww qqll	ww qqqq	zz llll	zz qqll	zz qqqq	γγ	gg	ττ	μμ
befo	14300	677	7	617	2517	2517	61	289	340	109	1752	1809	5
aft	4511	209	0	177	623	687	13	57	100	27	539	459	2
ε	31.5	30.9	0	28.7	24.8	27.3	21.3	19.7	29.4	24.8	30.8	25.4	20.0

Process ZH -> qqH @ 500 GeV (-0.8, +0.3)



ε ~ 32.2%

ΔσHZ/σHZ ~ 3.0%



ε ~ 32.0%

ΔσHZ/σHZ ~ 3.0%

H→	bb	cc	ss	WW llll	WW qqll	WW qqqq	ZZ llll	ZZ qqll	ZZ qqqq	γγ	gg	ττ	μμ
befo	14113	687	5	551	2557	2658	67	280	333	124	1712	1907	6
aft	4736	233	2	174	738	795	16	74	92	36	489	531	2
ε	33.6	33.9	40.0	31.6	28.9	29.9	23.8	26.5	27.6	29.0	28.6	27.8	33.3

26.5 ~ 33.9 %

except low statistics channel

H→	bb	cc	ss	WW llll	WW qqll	WW qqqq	ZZ llll	ZZ qqll	ZZ qqqq	γγ	gg	ττ	μμ
befo	14113	687	5	551	2557	2658	67	280	333	124	1712	1907	6
aft	4828	250	1	179	721	819	18	80	94	44	483	521	3
ε	34.2	36.4	20.0	32.5	28.2	30.8	26.9	28.6	28.2	35.5	28.2	27.3	50.0

27.3 ~ 36.4 %

except low statistics channel

For now, I can not observe remarkable difference between SiECAL and ScECAL.

But,
Each cut have not optimized yet.
MI does not keep same efficiency.
Need to try more detailed analysis.
And also apply MVA method.