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

June, 21, 2014
T. Ogawa

Today's report :

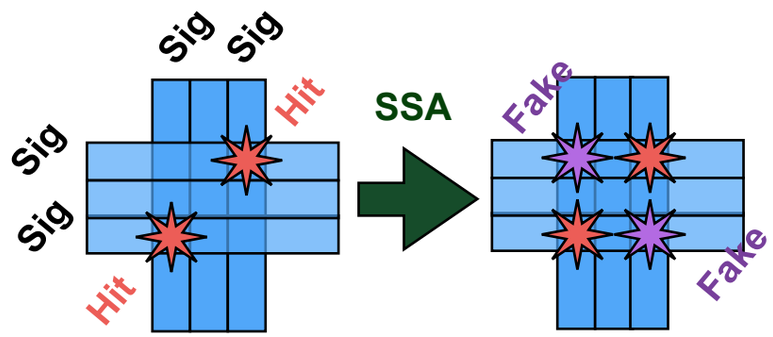
➡ Recoil mass of qq channel in visible and invisible higgs decay with cut base selection.

My Motivation

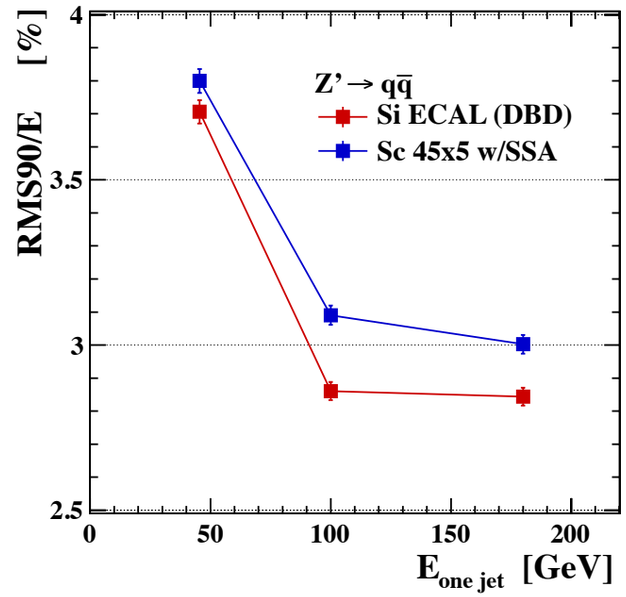
- My motivation is to compare performance between SiECAL and ScECAL

- JER b/w Si and Sc is slightly difference, ~ 0.3%.
- Sc has problem due to fake hits.

▶ Problem of fake hits



▶ Jet Energy Resolution

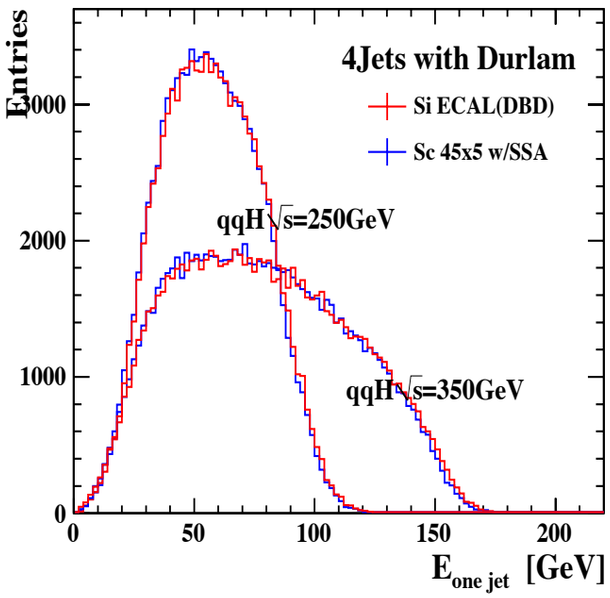


- How about physics analysis?

- For my fist test,
  confirm how large the difference appear
  by using recoil mass analysis (μμ, ee, qq)

  μμ → This doesn't depend on ECAL.
  ee → This also doesn't depend on ECAL. I hope…
  qq → How large does the difference appear?

▶ Energy of one jet in qqH



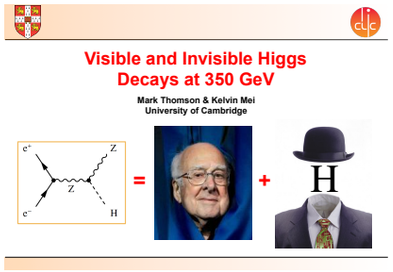
My Simulation condition & Analysis flow

- Simulation condition

- Analysis channel is qq.
- √s is 350GeV(L=350fb^-1), 250GeV(L=250fb^-1), 500GeV(L=500fb^-1).
  Beam polarization is (-0.8, +0.3)

- Signal is full reconstructed by using SiECAL and ScECAL.
  ZH ➡ qqH : H ➡ visible decay (SM).
  ZH ➡ qqH : H ➡ invisible decay (?). (I set this to H->ZZ->vvvv.)
- 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 (0th approximation).

- Analysis flow : Basically I follow M.Thomson's analysis



Force events into 2-Jets, 3-Jets, 4-Jets and 5-Jets with Durham.

➡ Visible analysis (treat as 4-Jets/5-Jets) & InVisible analysis (treat as 2-Jets)

➡ Cut Base selection or MVA Base selection

My Analysis flow

- Need to keep same selection efficiency for higgs decays to keep MI.

- Visible analysis (treat as 4-Jets/5-Jets) (Now I use 3-Jets, 4-Jets and 5-Jets)

➡ Default is to treat as 4-jets

5-jets reconstruction gives “better” Z mass and “better” Higgs recoil mass.

➡ treat as 5-jets

- Main BG : ZZ/WW ➡ qqll, qqqq. WW ➡ qqlv.

- Target Cut ➡ Other Cut for BG suppression.

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.

- InVisible analysis (treat as 2-Jets)

- Main BG : ZZ ➡ qqll, qqvv. WW ➡ qqlv.

- Target Cut ➡ Other Cut for BG suppression.

Higgs Visible decay analysis

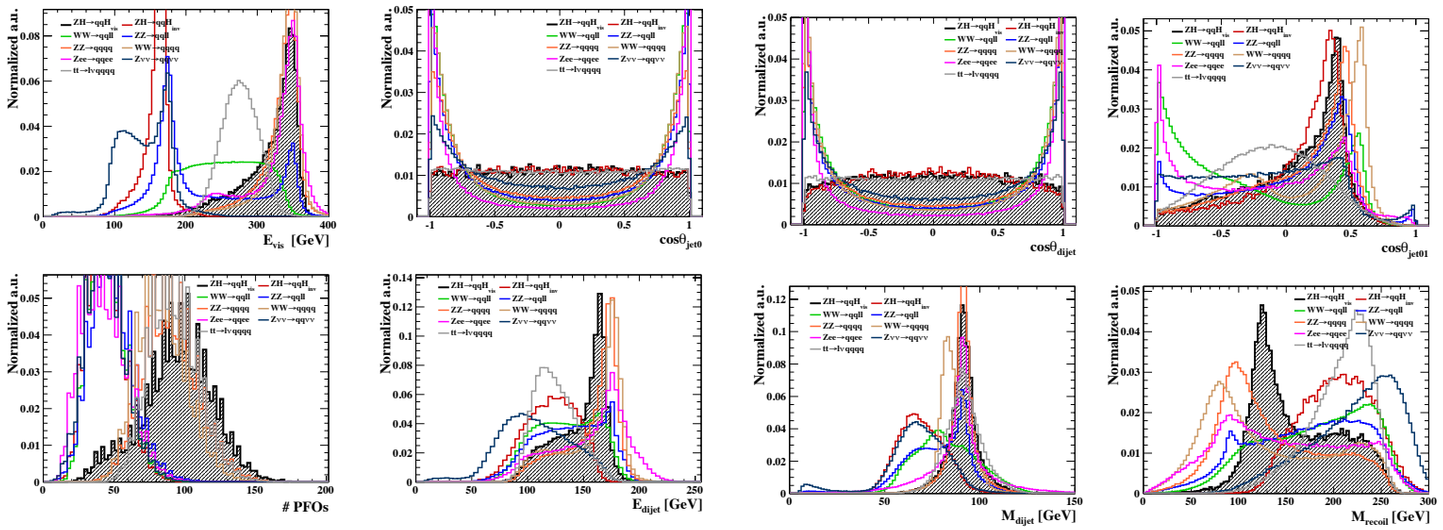
- For 350GeV (350fb^-1) (-0.8, +0.3) visible analysis.

- Target-cut (Pre-cut)

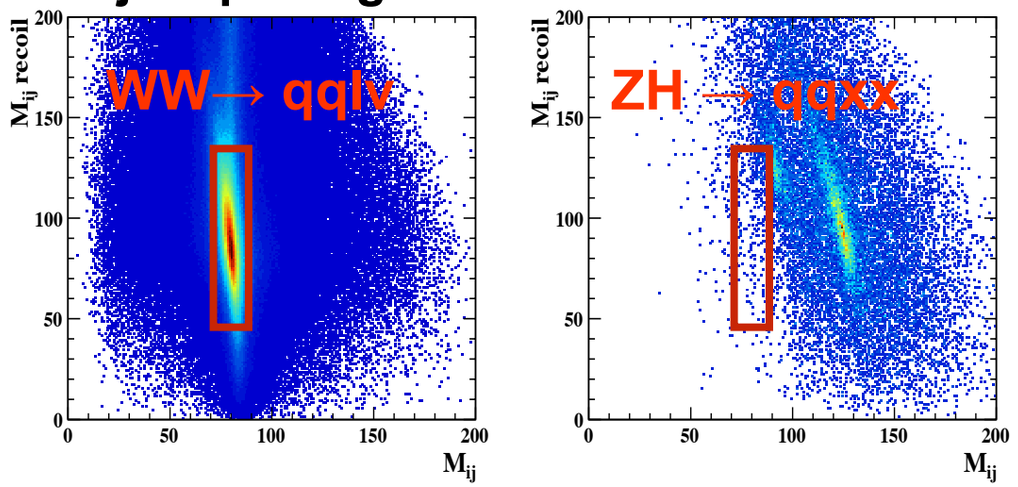
  Main BG : ZZ/WW ➡ qqll, qqqq. WW ➡ qqlv.

- Other kinematic/topology cut

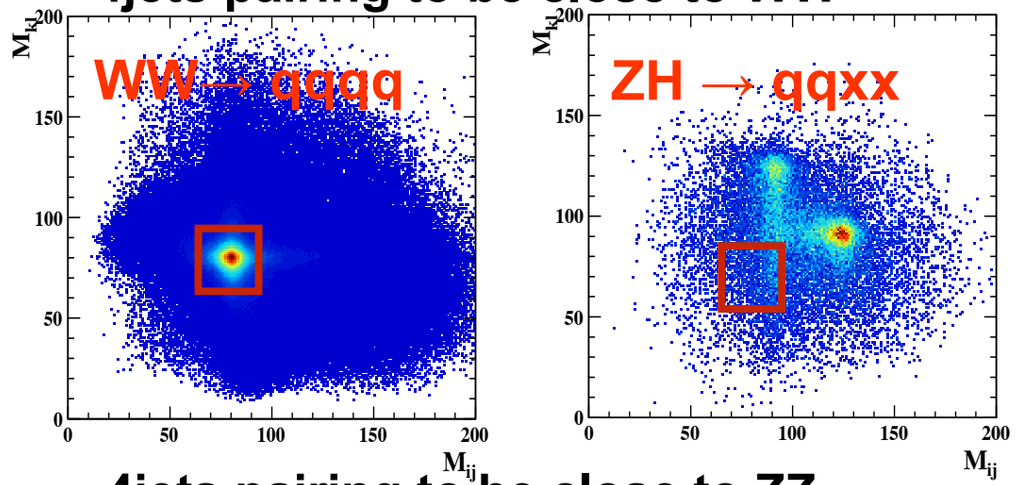
visE < 352	nPFOs < 140
|cosθjet1| <0.95	|cosθjet2| <0.95
-0.8 < |cosθjet12| <0.4	|cosθZ| <0.95
Pt^2_jet1>1500	100< E_z < 172
85 < M_z <105	100< Mrecoil < 200



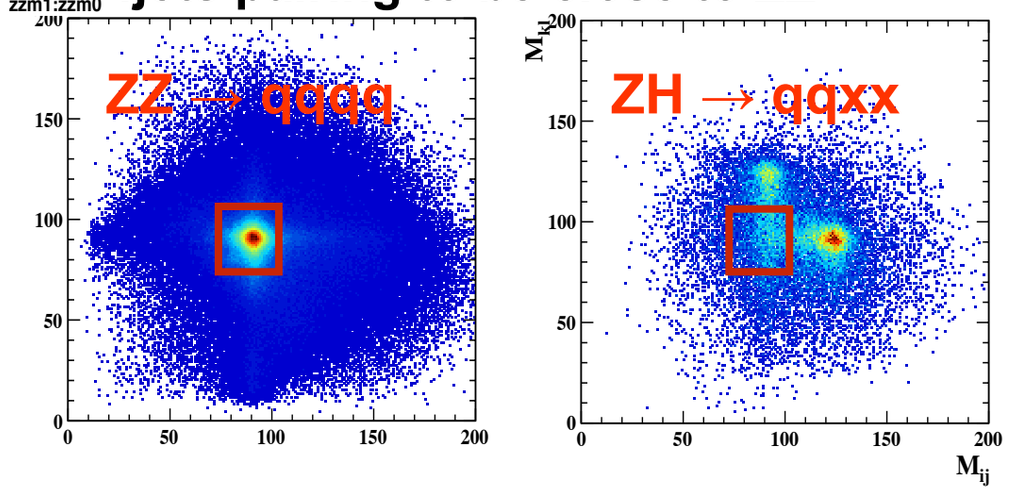
3jets pairing to be close to W



4jets pairing to be close to WW



4jets pairing to be close to ZZ



Higgs InVisible decay analysis

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

- Target-cut (Pre-cut)

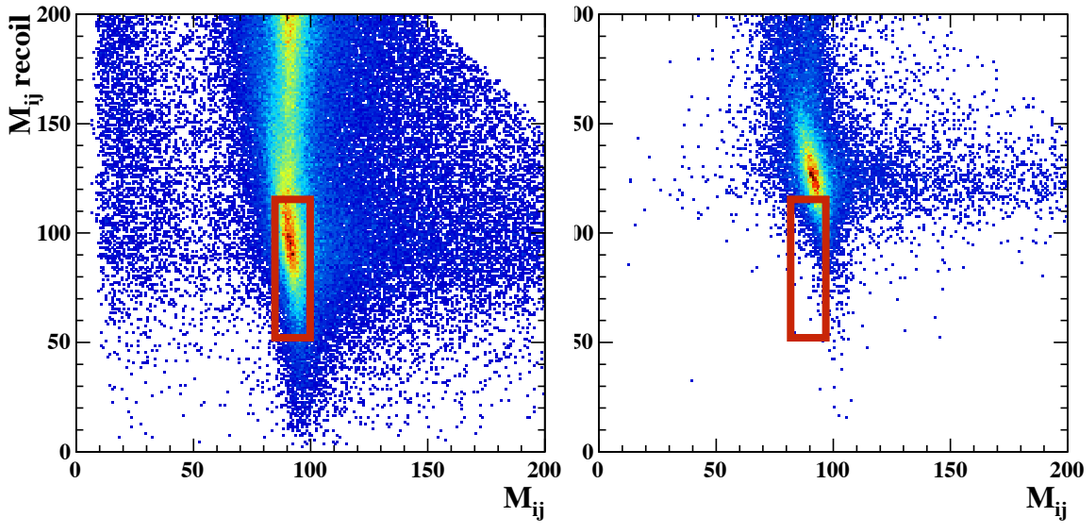
  Main BG : ZZ/WW ➡ qqll, qqqq. WW ➡ qqlv.

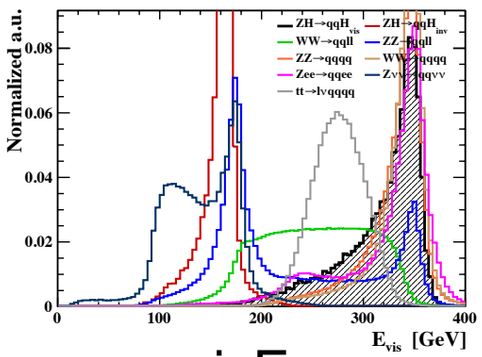
- Other kinematic/topology cut

100< visE < 180	nPFOs < 140
|cosθjet1| <0.95	|cosθjet2| <0.95
-0.1 < |cosθjet12| <0.4	|cosθZ| <0.75
Pt^2_jet1>1500	100< E_z < 172
85 < M_z <105	100< Mrecoil < 200

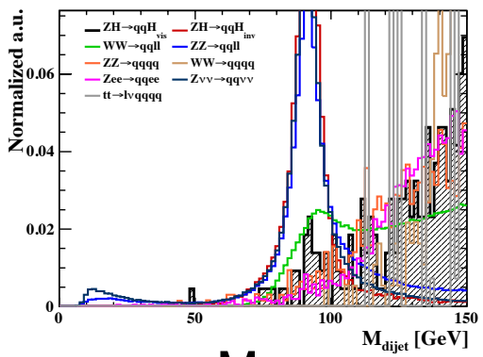
2jets clustring

ZZ→ qqvv ZH → qqxx

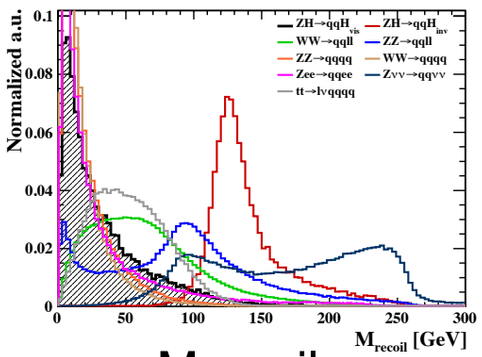




visE



M_z



Mrecoil

3.1 Si qqH 250GeV

$\sqrt{s}$=250GeV, L=250fb^{-1}, P(e^-, e^+) = P($-0.8, +0.3$).
- Signal is full reconstructed with SiECAL.
- Sig data (raw data) is 25K events. - BG data (raw data) is DST sample.

Process	$\sigma \cdot L$	$\epsilon^{vis}_{pre-sel}$	$\epsilon^{vis}_{all-sel}$	$N^{vis}_{all-sel}$	$\epsilon^{inv}_{all-sel}$	$N^{inv}_{all-sel}$	$\epsilon^{vis+inv}$
ZH	53059 (norm)	**77.5**%	47.8%	25322 (norm)	51.6%	-	-
$H \to b\bar{b}$	14198 (raw)	-%	47.9%	6810 (raw)	0.0%	-	47.9%
$H \to c\bar{c}$	708 (raw)	-%	50.5%	358 (raw)	0.0%	-	50.5%
$H \to s\bar{s}$	8 (raw)	-%	62.5%	5 (raw)	0.0%	-	62.5%
$H \to gluglu$	1683 (raw)	-%	48.8%	822 (raw)	0.0%	-	48.8%
$H \to \gamma\gamma$	75 (raw)	-%	48.0%	36 (raw)	0.0%	-	48.0%
$H \to \tau\tau$	1827 (raw)	-%	41.6%	760 (raw)	0.5%	10 (raw)	42.1%
$H \to \mu\mu$	12 (raw)	-%	41.7%	5 (raw)	0.0%	-	40.0%
$H \to WW^* \to qqqq$	2586 (raw)	-%	50.7%	1311 (raw)	0.0%	-	50.7%
$H \to WW^* \to qqll$	2565 (raw)	-%	47.3%	1213 (raw)	0.0%	-	47.3%
$H \to WW^* \to llll$	600 (raw)	-%	46.8%	281 (raw)	0.2%	1 (raw)	47.0%
$H \to \gamma Z$	55 (raw)	-%	50.9%	28 (raw)	0.0%	-	50.9%
$H \to ZZ^* \to qqqq$	364 (raw)	-%	50.5%	184 (raw)	0.0%	-	50.5%
$H \to ZZ^* \to qqll$	262 (raw)	-%	50.0%	131 (raw)	0.7%	2 (raw)	50.7%
$H \to ZZ^* \to llll$	57 (raw)	-%	24.6%	14 (raw)	22.0%	7 (raw)	46.6%
$H \to$ invisible	-	-%	0.3%	-	51.6%	-	51.6%
$Z \to qq$	2.0×10^7 (norm)	-%	5.5%	1.1×10^6 (norm)	<0.1%	0	-
$ZZ \to qqqq$	2.1×10^5 (norm)	-%	35.2%	74428 (norm)	0.0%	2312	-
$ZZ \to qqll$	2.1×10^5 (norm)	-%	12.8%	27308 (norm)	2.4%	5410 (norm)	-
$WW \to qqqq$	2.2×10^6 (norm)	-%	23.2%	496872 (norm)	0.0%	0	-
$WW \to qqll$	2.0×10^5 (norm)	-%	8.7%	18082 (norm)	0.42%	867 (norm)	-
$Zvv \to qqvv$	6.8×10^4 (norm)	-%	1.53%	1033 (norm)	12.4%	9651 (norm)	-
$Zee \to qqee$	7.0×10^4 (norm)	-%	15.7%	11866 (norm)	0.0%	0	-

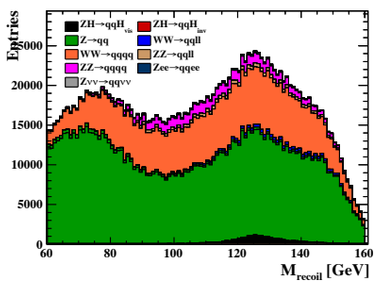
- Count the number of events. $\to \Delta\sigma_{HZ}/\sigma_{HZ} = \sqrt{S_{vis} + N_{(vis+inv)}}/S_{vis} = \pm 5.3\%$ ($q\bar{q}$ channnel).

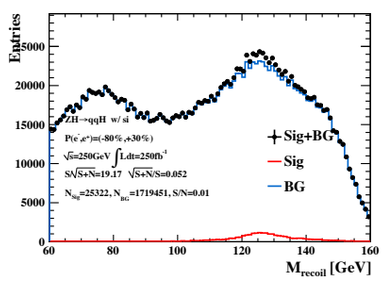
3.2 Sc qqH 250GeV

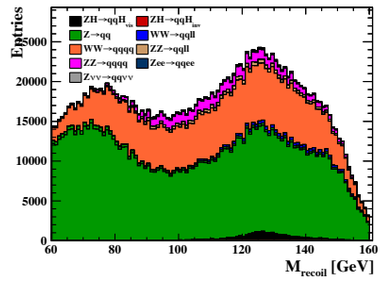
$\sqrt{s}$=250GeV, L=250fb^{-1}, P(e^-, e^+) = P($-0.8, +0.3$).
Signal is full reconstructed with ScECAL.
- Sig data (raw data) is 25K events. - BG data (raw data) is DST sample.

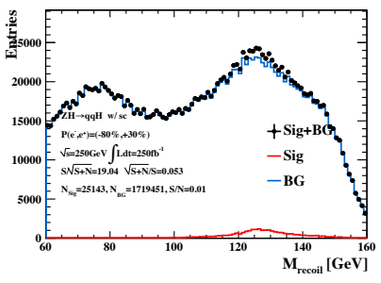
Process	$\sigma \cdot L$	$\epsilon^{vis}_{pre-sel}$	$\epsilon^{vis}_{all-sel}$	$N^{vis}_{all-sel}$	$\epsilon^{inv}_{all-sel}$	$N^{inv}_{all-sel}$	$\epsilon^{vis+inv}$
ZH	53059 (norm)	**78.7**%	47.5%	25143 (norm)	51.6%	-	-
$H \to b\bar{b}$	14198 (raw)	-%	48.0%	6822 (raw)	0.0%	-	48.0%
$H \to c\bar{c}$	708 (raw)	-%	52.6%	373 (raw)	0.0%	-	52.6%
$H \to s\bar{s}$	8 (raw)	-%	62.5%	5 (raw)	0.0%	-	62.5%
$H \to gluglu$	1683 (raw)	-%	45.2%	760 (raw)	0.0%	-	45.2%
$H \to \gamma\gamma$	75 (raw)	-%	48.5%	34 (raw)	0.0%	-	48.5%
$H \to \tau\tau$	1827 (raw)	-%	41.0%	747 (raw)	0.55%	10 (raw)	42.0%
$H \to \mu\mu$	12 (raw)	-%	25.0%	3 (raw)	0.0%	-	25.0%
$H \to WW^* \to qqqq$	2586 (raw)	-%	50.7%	1313 (raw)	0.0%	-	50.7%
$H \to WW^* \to qqll$	2565 (raw)	-%	47.4%	1216 (raw)	0.0%	-	47.4%
$H \to WW^* \to llll$	600 (raw)	-%	43.8%	263 (raw)	0.5%	3 (raw)	44.3%
$H \to \gamma Z$	55 (raw)	-%	52.7%	29 (raw)	0.0%	-	52.7%
$H \to ZZ^* \to qqqq$	364 (raw)	-%	50.3%	183 (raw)	0.0%	-	50.3%
$H \to ZZ^* \to qqll$	262 (raw)	-%	43.5%	114 (raw)	0.4%	1 (raw)	43.9%
$H \to ZZ^* \to llll$	57 (raw)	-%	21.1%	12 (raw)	21.1%	12 (raw)	42.2%
$H \to$ invisible	-	-%	0.16%	-	50.7%	-	50.9%
$Z \to qq$	2.0×10^7 (norm)	-%	5.5%	1.1×10^6 (norm)	<0.1%	0	-
$ZZ \to qqqq$	2.1×10^5 (norm)	-%	35.2%	74428 (norm)	0.0%	2312	-
$ZZ \to qqll$	2.1×10^5 (norm)	-%	12.8%	27308 (norm)	2.4%	5410 (norm)	-
$WW \to qqqq$	2.2×10^6 (norm)	-%	23.2%	496872 (norm)	0.0%	0	-
$WW \to qqll$	2.0×10^5 (norm)	-%	8.7%	18082 (norm)	0.42%	867 (norm)	-
$Zvv \to qqvv$	6.8×10^4 (norm)	-%	1.53%	1033 (norm)	12.4%	9651 (norm)	-
$Zee \to qqee$	7.0×10^4 (norm)	-%	15.7%	11866 (norm)	0.0%	0	-

- Count the number of events. $\to \Delta\sigma_{HZ}/\sigma_{HZ} = \sqrt{S_{vis} + N_{(vis+inv)}}/S_{vis} \sim \pm 5.3\%$ ($q\bar{q}$ channnel).









- Selection ε of higgs is almost MI. but tau is not same.

- Cut ε and remaining N are almost same b/w two ECALs .

- MI with Sc become a little bit worse than Si (for now).

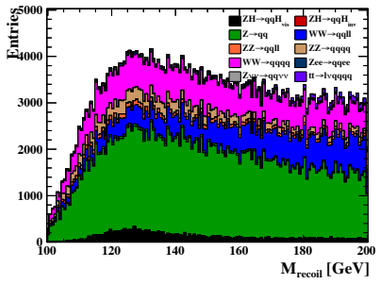
- ΔσHZ/σHZ with Si or Sc ~ ± 5.3%

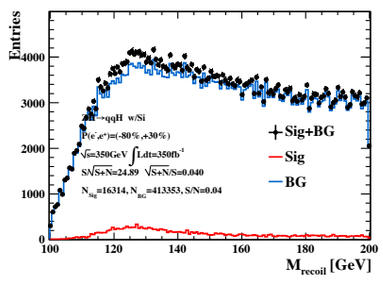
6.1 Si qqH 350GeV

$\sqrt{s}$=350GeV, L=350fb^{-1}, P(e^-, e^+) = P($-0.8, +0.3$).
Signal is full reconstructed with SiECAL.
- Sig data (raw data) is 25K events. - BG data (raw data) is DST sample.

Process	$\sigma \cdot L$	$\epsilon^{vis}_{pre-sel}$	$\epsilon^{vis}_{all-sel}$	$N^{vis}_{all-sel}$	$\epsilon^{inv}_{all-sel}$	$N^{inv}_{all-sel}$	$\epsilon^{vis+inv}$
ZH	49926 (norm)	73.2%	32.7%	16314 (norm)	29.2%	-	-
$H \to b\bar{b}$	14300 (raw)	76.7%	35.8%	5127 (raw)	0.0%	-	35.8%
$H \to c\bar{c}$	677 (raw)	70.9%	30.7%	208 (raw)	0.0%	-	30.7%
$H \to s\bar{s}$	7 (raw)	71.4%	28.6%	2 (raw)	0.0%	-	28.6%
$H \to gluglu$	1752 (raw)	64.5%	27.3%	478 (raw)	0.0%	-	27.3%
$H \to \gamma\gamma$	73 (raw)	61.6%	31.5%	23 (raw)	0.0%	-	31.5%
$H \to \tau\tau$	1809 (raw)	62.7%	26.3%	470 (raw)	0.1%	2 (raw)	26.4%
$H \to \mu\mu$	5 (raw)	40.0%	40.0%	2 (raw)	0.0%	-	40.0%
$H \to WW^* \to qqqq$	2517 (raw)	68.9%	28.2%	709 (raw)	0.0%	-	28.2%
$H \to WW^* \to qqll$	2517 (raw)	71.5%	29.7%	747 (raw)	0.0%	-	29.7%
$H \to WW^* \to llll$	617 (raw)	78.4%	29.8%	184 (raw)	0.3%	2 (raw)	30.1%
$H \to \gamma Z$	36 (raw)	63.9%	22.2%	8 (raw)	0.0%	-	22.2%
$H \to ZZ^* \to qqqq$	340 (raw)	74.1%	29.4%	100 (raw)	0.0%	-	29.4%
$H \to ZZ^* \to qqll$	289 (raw)	71.9%	31.8%	92 (raw)	0.0%	-	31.8%
$H \to ZZ^* \to llll$	61 (raw)	63.9%	21.3%	13 (raw)	11.4%	7 (raw)	32.7%
$H \to$ invisible	-	53.6%	0.5%	-	29.2%	-	29.7%
$Z \to qq$	1.4×10^7 (norm)	-%	2.1%	2.3×10^5 (norm)	0.0%	0	-
$ZZ \to qqqq$	2.1×10^5 (norm)	42.2%	11.1%	24495 (norm)	0.0%	0	-
$ZZ \to qqll$	2.0×10^5 (norm)	49.9%	4.8%	9393 (norm)	1.6%	3502 (norm)	-
$WW \to qqqq$	2.2×10^6 (norm)	23.3%	3.4%	78981 (norm)	0.0%	0	-
$WW \to qqll$	2.9×10^6 (norm)	30.5%	2.2%	6353 (norm)	0.2%	4059 (norm)	-
$Zvv \to qqvv$	1.2×10^5 (norm)	62.4%	3.5%	869 (norm)	5.4%	7124 (norm)	-
$Zee \to qqee$	1.0×10^5 (norm)	44.3%	4.4%	5464 (norm)	0.0%	0	-
$t\bar{t} \to qqqqlv$	2.6×10^4 (norm)	84.9%	18.0%	4814 (norm)	0.0%	0	-

- Count the number of events. $\to \Delta\sigma_{HZ}/\sigma_{HZ} = \sqrt{S_{vis} + N_{(vis+inv)}}/S_{vis} = \pm 4.0\%$ ($q\bar{q}$ channnel).



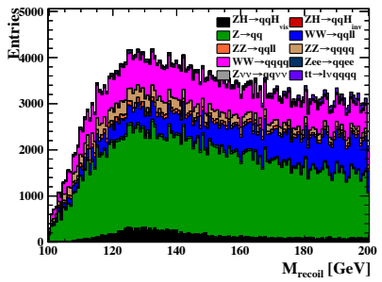


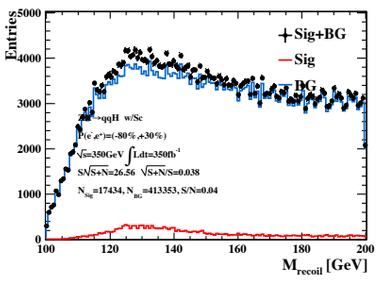
6.2 Sc qqH 350GeV

$\sqrt{s}$=350GeV, L=350fb^{-1}, P(e^-, e^+) = P($-0.8, +0.3$).
Signal is full reconstructed with ScECAL.
- Sig data (raw data) is 25K events. - BG data (raw data) is DST sample.

Process	$\sigma \cdot L$	$\epsilon^{vis}_{pre-sel}$	$\epsilon^{vis}_{all-sel}$	$N^{vis}_{all-sel}$	$\epsilon^{inv}_{all-sel}$	$N^{inv}_{all-sel}$	$\epsilon^{vis+inv}$
ZH	49926 (norm)	77.1%	34.9%	17434 (norm)	30.8%	-	-
$H \to b\bar{b}$	14300 (raw)	81.3%	38.2%	5461 (raw)	0.0%	-	38.2%
$H \to c\bar{c}$	677 (raw)	79.0%	34.4%	233 (raw)	0.0%	-	34.4%
$H \to s\bar{s}$	7 (raw)	85.7%	14.3%	1 (raw)	0.0%	-	14.3%
$H \to gluglu$	1752 (raw)	70.7%	31.8%	557 (raw)	0.0%	-	31.8%
$H \to \gamma\gamma$	73 (raw)	75.3%	35.6%	10 (raw)	0.0%	-	35.6%
$H \to \tau\tau$	1809 (raw)	60.5%	24.9%	450 (raw)	0.2%	3 (raw)	25.1%
$H \to \mu\mu$	5 (raw)	80.0%	60.0%	3 (raw)	0.0%	-	60.0%
$H \to WW^* \to qqqq$	2517 (raw)	77.1%	33.1%	834 (raw)	0.0%	-	33.1%
$H \to WW^* \to qqll$	2517 (raw)	70.3%	31.2%	786 (raw)	0.0%	-	31.2%
$H \to WW^* \to llll$	617 (raw)	75.0%	25.8%	159 (raw)	0.3%	2 (raw)	26.1%
$H \to \gamma Z$	36 (raw)	80.5%	27.8%	10 (raw)	0.0%	-	27.8%
$H \to ZZ^* \to qqqq$	340 (raw)	80.6%	34.1%	116 (raw)	0.0%	-	34.1%
$H \to ZZ^* \to qqll$	289 (raw)	68.5%	28.4%	82 (raw)	0.0%	-	28.4%
$H \to ZZ^* \to llll$	61 (raw)	64.0%	19.7%	12 (raw)	11.4%	7 (raw)	31.1%
$H \to$ invisible	-	62.3%	0.6%	-	30.8%	-	31.4%
$Z \to qq$	1.4×10^7 (norm)	-%	2.1%	2.3×10^5 (norm)	0.0%	0	-
$ZZ \to qqqq$	2.1×10^5 (norm)	42.2%	11.1%	24495 (norm)	0.0%	0	-
$ZZ \to qqll$	2.0×10^5 (norm)	49.9%	4.8%	9393 (norm)	1.6%	3502 (norm)	-
$WW \to qqqq$	2.2×10^6 (norm)	23.3%	3.4%	78981 (norm)	0.0%	0	-
$WW \to qqll$	2.9×10^6 (norm)	30.5%	2.2%	6353 (norm)	0.2%	4059 (norm)	-
$Zvv \to qqvv$	1.2×10^5 (norm)	62.4%	3.5%	869 (norm)	5.4%	7124 (norm)	-
$Zee \to qqee$	1.0×10^5 (norm)	44.3%	4.4%	5464 (norm)	0.0%	0	-
$t\bar{t} \to qqqqlv$	2.6×10^4 (norm)	84.9%	18.0%	4814 (norm)	0.0%	0	-

- Count the number of events. $\to \Delta\sigma_{HZ}/\sigma_{HZ} = \sqrt{S_{vis} + N_{(vis+inv)}}/S_{vis} = \pm ??\%$ ($q\bar{q}$ channnel).





- Selection ε of higgs is almost MI. but bb is high.

- Cut ε of Sc is different about 2% and remaining N is larger about 7.5% than Si.

- MI with Sc become a little bit worse than Si (for now).

- ΔσHZ/σHZ with Si ~ ± 4.0% (counted events)

Today's summary & Next step

- I analyzed recoil mass process with two ECAL options.

- Concerning lepton channel with cut base selection,
  there is not remarkable difference between two options.

  (I reported previous meeting, and also attached my summary as back up slides.)

- Concerning qq channel with cut base selection,
  there is not remarkable difference at 250 GeV.

  ΔσHZ/σHZ with Si or Sc ~ ± 5.3% (counted events)

- In case of 350 GeV,
  remaining signal events of Sc after applied BG cut is larger ~ 7.5% than one of Si.
  also MI with Sc become a little bit worse.

  ➡ This is due to the difference (~0.3%) of JER.

  ΔσHZ/σHZ with Si ~ ± 4.0% (counted events)

  ΔσHZ/σHZ with Sc ~ ± ?.?% (counted events)

  ➡ If I estimate this, I need to generate BG with Sc?.

- Try to apply MVA selection.

Back up Slides

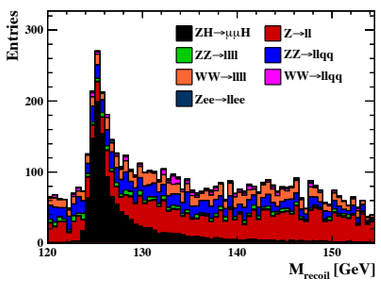
Summary of Recoil Mass@ 250GeV, P(-0.8, +0.3) Cut Base Selection

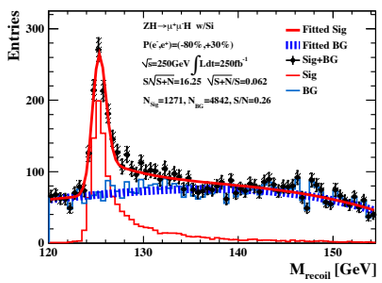
1.1 Si $\mu\mu$H 250GeV

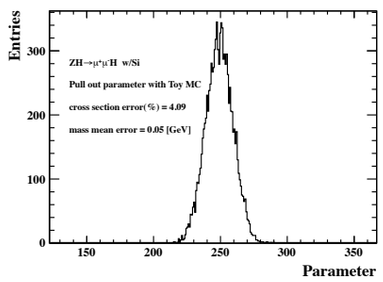
- $\sqrt{s}$=250GeV, L=250fb^{-1}, P(e^-, e^+) = P$(-0.8, +0.3)$.
- Signal is full reconstructed with SiECAL.
- Sig data (raw data) is 25K events. - BG data (raw data) is DST sample.

Process	$\sigma \cdot L$	$\epsilon^{vis}_{all-sel}$	$N^{vis}_{all-sel}$	$\epsilon^{inv}_{all-sel}$	$N^{inv}_{all-sel}$	$\epsilon^{vis+inv}$
ZH	2619 (norm)	49.0%	1284 (norm)	-%	-	-
$H \to b\bar{b}$	14245 (raw)	49.1 %	6998 (raw)	-%	-	-%
$H \to c\bar{c}$	674 (raw)	48.2 %	325 (raw)	-%	-	-%
~~$H \to s\bar{s}$~~	~~6 (raw)~~	~~33.3 %~~	~~2 (raw)~~	~~-%~~	~~-~~	~~-%~~
$H \to gluglu$	1687 (raw)	48.0 %	810 (raw)	-%	-	-%
$H \to \tau\tau$	1953 (raw)	48.6 %	950 (raw)	-%	-	-%
~~$H \to \mu\mu$~~	~~9 (raw)~~	~~66.6 %~~	~~6 (raw)~~	~~-%~~	~~-~~	~~-%~~
~~$H \to \gamma\gamma$~~	~~74 (raw)~~	~~48.6 %~~	~~36 (raw)~~	~~-%~~	~~-~~	~~-%~~
~~$H \to \gamma Z$~~	~~48 (raw)~~	~~50 %~~	~~24 (raw)~~	~~-%~~	~~-~~	~~-%~~
$H \to WW^*$	5624 (raw)	49.0 %	2754 (raw)	-%	-	-%
$H \to WW^* \to qqqq$	2595 (raw)	49.6 %	1286 (raw)	-%	-	-%
$H \to WW^* \to qqll$	2410 (raw)	47.8 %	1154 (raw)	-%	-	-%
$H \to WW^* \to llll$	619 (raw)	50.7 %	314 (raw)	-%	-	-%
$H \to ZZ^*$	680 (raw)	51.3 %	349 (raw)	-%	-	-%
$H \to ZZ^* \to qqqq$	328 (raw)	52.7 %	173 (raw)	-%	-	-%
$H \to ZZ^* \to qqll$	297 (raw)	49.2 %	146 (raw)	-%	-	-%
~~$H \to ZZ^* \to llll$~~	~~55 (raw)~~	~~54.5 %~~	~~30 (raw)~~	~~-%~~	~~-~~	~~-%~~
$H \to$ invisible	-	-%	-	-%	-	-%
$Z \to ll$	3.2×10^6 (norm)	<0.1%	2352 (norm)	-%	-	-
$ZZ \to llll$	2.4×10^4 (norm)	0.96%	254 (norm)	-%	-	-
$ZZ \to qqll$	2.1×10^5 (norm)	0.45%	1049 (norm)	-%	-	-
$WW \to llll$	2.3×10^5 (norm)	0.39%	901 (norm)	-%	-	-
$WW \to qqll$	2.7×10^6 (norm)	<0.1%	166 (norm)	-%	-	-
$Zee \to llee$	1.7×10^5 (norm)	<0.1%	119 (norm)	-%	-	-

- Count the number of events. $\to \Delta\sigma_{HZ}/\sigma_{HZ} = \sqrt{S_{vis} + N_{(vis)}}/S_{vis} = \pm 6.1\%$ ($\mu\mu$ channnel).
- Toy MC. $\to \Delta\sigma_{HZ}/\sigma_{HZ} = \pm 4.1\%$ ($\mu\mu$ channnel).





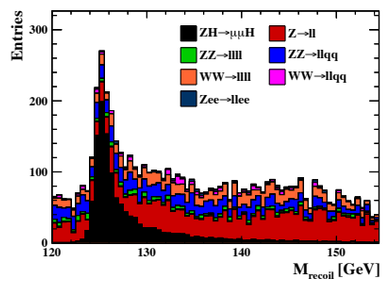


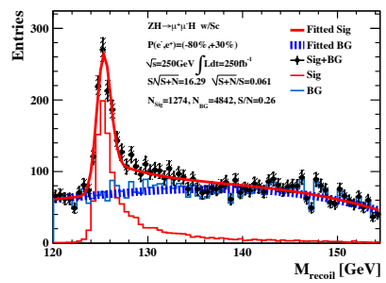
1.2 Sc $\mu\mu$H 250GeV

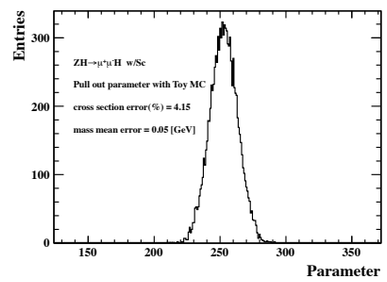
- $\sqrt{s}$=250GeV, L=250fb^{-1}, P(e^-, e^+) = P$(-0.8, +0.3)$.
- Signal is full reconstructed with ScECAL.
- Sig data (raw data) is 25K events. - BG data (raw data) is DST sample.

Process	$\sigma \cdot L$	$\epsilon^{vis}_{all-sel}$	$N^{vis}_{all-sel}$	$\epsilon^{inv}_{all-sel}$	$N^{inv}_{all-sel}$	$\epsilon^{vis+inv}$
ZH	2619 (norm)	49.1%	1285 (norm)	-%	-	-
$H \to b\bar{b}$	14245 (raw)	49.2 %	7005 (raw)	-%	-	-%
$H \to c\bar{c}$	674 (raw)	48.1 %	324 (raw)	-%	-	-%
~~$H \to s\bar{s}$~~	~~6 (raw)~~	~~33.3 %~~	~~2 (raw)~~	~~%~~		~~%~~
$H \to gluglu$	1687 (raw)	47.5 %	802 (raw)	-%	-	-%
$H \to \tau\tau$	1953 (raw)	48.6 %	949 (raw)	-%	-	-%
~~$H \to \mu\mu$~~	~~9 (raw)~~	~~55.6 %~~	~~5 (raw)~~	~~-%~~	~~-~~	~~-%~~
~~$H \to \gamma\gamma$~~	~~74 (raw)~~	~~47.3 %~~	~~35 (raw)~~	~~-%~~	~~-~~	~~-%~~
~~$H \to \gamma Z$~~	~~48 (raw)~~	~~54.2 %~~	~~26 (raw)~~	~~-%~~	~~-~~	~~-%~~
$H \to WW^*$	5624 (raw)	49.2 %	2765 (raw)	-%	-	-%
$H \to WW^* \to qqqq$	2595 (raw)	49.9 %	1297 (raw)	-%	-	-%
$H \to WW^* \to qqll$	2410 (raw)	48.1 %	1158 (raw)	-%	-	-%
$H \to WW^* \to llll$	619 (raw)	50.0 %	310 (raw)	-%	-	-%
$H \to ZZ^*$	680 (raw)	51.8 %	352 (raw)	-%	-	-%
$H \to ZZ^* \to qqqq$	328 (raw)	53.4 %	175 (raw)	-%	-	-%
$H \to ZZ^* \to qqll$	297 (raw)	49.5 %	147 (raw)	-%	-	-%
~~$H \to ZZ^* \to llll$~~	~~55 (raw)~~	~~54.5 %~~	~~30 (raw)~~	~~-%~~	~~-~~	~~-%~~
$H \to$ invisible	-	-%	-	-%	-	-%
$Z \to ll$	3.2×10^6 (norm)	<0.1%	2352 (norm)	-%	-	-
$ZZ \to llll$	2.4×10^4 (norm)	0.96%	254 (norm)	-%	-	-
$ZZ \to qqll$	2.1×10^5 (norm)	0.45%	1049 (norm)	-%	-	-
$WW \to llll$	2.3×10^5 (norm)	0.39%	901 (norm)	-%	-	-
$WW \to qqll$	2.7×10^6 (norm)	<0.1%	166 (norm)	-%	-	-
$Zee \to llee$	1.7×10^5 (norm)	<0.1%	119 (norm)	-%	-	-

- Count the number of events. $\to \Delta\sigma_{HZ}/\sigma_{HZ} = \sqrt{S_{vis} + N_{(vis)}}/S_{vis} = \pm 6.1\%$ ($\mu\mu$ channnel).
- Toy MC. $\to \Delta\sigma_{HZ}/\sigma_{HZ} = \pm 4.2\%$ ($\mu\mu$ channnel).





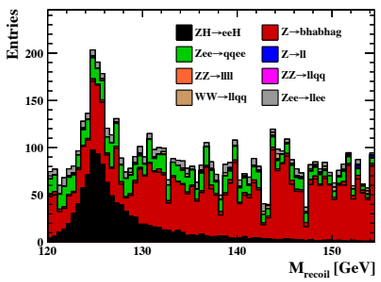


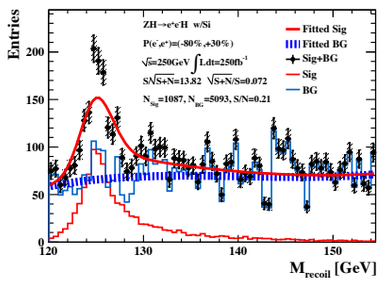
2.1 Si eeH 250GeV

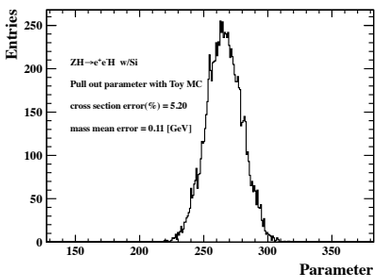
- $\sqrt{s}$=250GeV, L=250fb^{-1}, P(e^-, e^+) = P$(-0.8, +0.3)$.
- Signal is full reconstructed with SiECAL.
- Sig data (raw data) is 25K events. - BG data (raw data) is DST sample.

Process	$\sigma \cdot L$	$\epsilon^{vis}_{all-sel}$	$N^{vis}_{all-sel}$	$\epsilon^{inv}_{all-sel}$	$N^{inv}_{all-sel}$	$\epsilon^{vis+inv}$
ZH	2747 (norm)	39.6%	1087 (norm)	-%	-	-
$H \to b\bar{b}$	14177 (raw)	40.5 %	5740 (raw)	-%	-	-%
$H \to c\bar{c}$	672 (raw)	37.3 %	250 (raw)	-%	-	-%
~~$H \to s\bar{s}$~~	~~12 (raw)~~	~~50.0 %~~	~~6 (raw)~~	~~-%~~	~~-~~	~~-%~~
$H \to gluglu$	1671 (raw)	40.1 %	670 (raw)	-%	-	-%
$H \to \tau\tau$	1916 (raw)	40.1 %	769 (raw)	-%	-	-%
~~$H \to \mu\mu$~~	~~2 (raw)~~	~~0.0 %~~	~~0 (raw)~~	~~%~~	~~-~~	~~%~~
~~$H \to \gamma\gamma$~~	~~80 (raw)~~	~~27.5 %~~	~~22 (raw)~~	~~-%~~	~~-~~	~~-%~~
~~$H \to \gamma Z$~~	~~43 (raw)~~	~~32.6 %~~	~~14 (raw)~~	~~-%~~	~~-~~	~~-%~~
$H \to WW^*$	5764 (raw)	39.9 %	2298 (raw)	-%	-	-%
$H \to WW^* \to qqqq$	2636 (raw)	38.7 %	1021 (raw)	-%	-	-%
$H \to WW^* \to qqll$	2502 (raw)	41.1 %	1028 (raw)	-%	-	-%
$H \to WW^* \to llll$	626 (raw)	39.8 %	249 (raw)	-%	-	-%
$H \to ZZ^*$	663 (raw)	40.9 %	271 (raw)	-%	-	-%
$H \to ZZ^* \to qqqq$	317 (raw)	40.7 %	129 (raw)	-%	-	-%
$H \to ZZ^* \to qqll$	274 (raw)	39.5 %	108 (raw)	-%	-	-%
~~$H \to ZZ^* \to llll$~~	~~72 (raw)~~	~~47.2 %~~	~~34 (raw)~~	~~%~~	~~-~~	~~-%~~
$H \to$ invisible	-	-%	-	-%	-	-%
$ee \to ee(\gamma)$	3.9×10^6 (norm)	<0.1%	3632 (norm)	-%	-	-
$Z \to ll$	3.2×10^6 (norm)	<0.1%	32 (norm)	-%	-	-
$ZZ \to llll$	2.4×10^4 (norm)	<0.1%	2 (norm)	-%	-	-
$ZZ \to qqll$	2.1×10^5 (norm)	<0.1%	1 (norm)	-%	-	-
$WW \to llll$	2.3×10^5 (norm)	<0.1%	0 (norm)	-%	-	-
$WW \to qqll$	2.7×10^6 (norm)	<0.1%	74 (norm)	-%	-	-
$Zee \to qqee$	6.9×10^4 (norm)	1.2%	974 (norm)	-%	-	-
$Zee \to llee$	1.7×10^5 (norm)	0.17%	377 (norm)	-%	-	-

- Count the number of events. $\to \Delta\sigma_{HZ}/\sigma_{HZ} = \sqrt{S_{vis} + N_{(vis)}}/S_{vis} = \pm 7.2\%$ (ee channnel).
- Toy MC. $\to \Delta\sigma_{HZ}/\sigma_{HZ} = \pm 5.2\%$ (ee channnel).





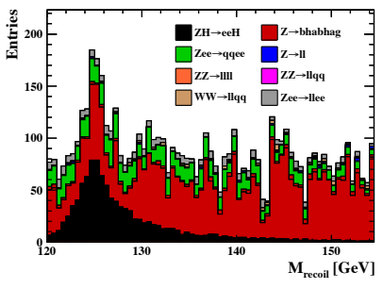


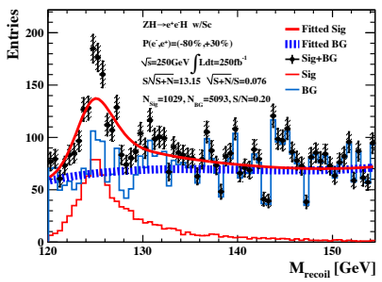
2.2 Sc eeH 250GeV

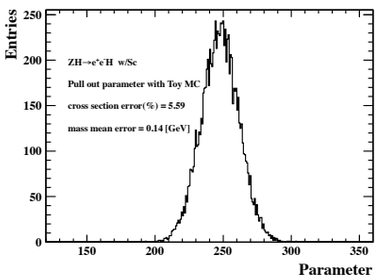
- $\sqrt{s}$=250GeV, L=250fb^{-1}, P(e^-, e^+) = P$(-0.8, +0.3)$.
- Signal is full reconstructed with ScECAL.
- Sig data (raw data) is 25K events. - BG data (raw data) is DST sample.

Process	$\sigma \cdot L$	$\epsilon^{vis}_{all-sel}$	$N^{vis}_{all-sel}$	$\epsilon^{inv}_{all-sel}$	$N^{inv}_{all-sel}$	$\epsilon^{vis+inv}$
ZH	2747 (norm)	37.4%	1029 (norm)	-%	-	-
$H \to b\bar{b}$	14177 (raw)	38.6 %	5476 (raw)	-%	-	-%
$H \to c\bar{c}$	672 (raw)	37.6 %	253 (raw)	-%	-	-%
~~$H \to s\bar{s}$~~	~~12 (raw)~~	~~41.7 %~~	~~5 (raw)~~	~~-%~~	~~-~~	~~-%~~
$H \to gluglu$	1671 (raw)	36.7 %	613 (raw)	-%	-	-%
$H \to \tau\tau$	1916 (raw)	38.2 %	732 (raw)	-%	-	-%
~~$H \to \mu\mu$~~	~~2 (raw)~~	~~0.0 %~~	~~0 (raw)~~	~~%~~	~~-~~	~~%~~
~~$H \to \gamma\gamma$~~	~~80 (raw)~~	~~31.2 %~~	~~25 (raw)~~	~~-%~~	~~-~~	~~-%~~
~~$H \to \gamma Z$~~	~~43 (raw)~~	~~30.2 %~~	~~13 (raw)~~	~~-%~~	~~-~~	~~-%~~
$H \to WW^*$	5764 (raw)	37.8 %	2179 (raw)	-%	-	-%
$H \to WW^* \to qqqq$	2636 (raw)	36.4 %	959 (raw)	-%	-	-%
$H \to WW^* \to qqll$	2502 (raw)	39.4 %	986 (raw)	-%	-	-%
$H \to WW^* \to llll$	626 (raw)	37.4 %	234 (raw)	-%	-	-%
$H \to ZZ^*$	663 (raw)	38.5 %	255 (raw)	-%	-	-%
$H \to ZZ^* \to qqqq$	317 (raw)	37.2 %	118 (raw)	-%	-	-%
$H \to ZZ^* \to qqll$	274 (raw)	37.2 %	102 (raw)	-%	-	-%
~~$H \to ZZ^* \to llll$~~	~~72 (raw)~~	~~48.6 %~~	~~35 (raw)~~	~~-%~~	~~-~~	~~-%~~
$H \to$ invisible	-	-%	-	-%	-	-%
$ee \to ee(\gamma)$	3.9×10^6 (norm)	<0.1%	3632 (norm)	-%	-	-
$Z \to ll$	3.2×10^6 (norm)	<0.1%	32 (norm)	-%	-	-
$ZZ \to llll$	2.4×10^4 (norm)	<0.1%	2 (norm)	-%	-	-
$ZZ \to qqll$	2.1×10^5 (norm)	<0.1%	1 (norm)	-%	-	-
$WW \to llll$	2.3×10^5 (norm)	<0.1%	0 (norm)	-%	-	-
$WW \to qqll$	2.7×10^6 (norm)	<0.1%	74 (norm)	-%	-	-
$Zee \to qqee$	6.9×10^4 (norm)	1.2%	974 (norm)	-%	-	-
$Zee \to llee$	1.7×10^5 (norm)	0.17%	377 (norm)	-%	-	-

- Count the number of events. $\to \Delta\sigma_{HZ}/\sigma_{HZ} = \sqrt{S_{vis} + N_{(vis)}}/S_{vis} = \pm 7.6\%$ (ee channnel).
- Toy MC. $\to \Delta\sigma_{HZ}/\sigma_{HZ} = \pm 5.4\%$ (ee channnel).





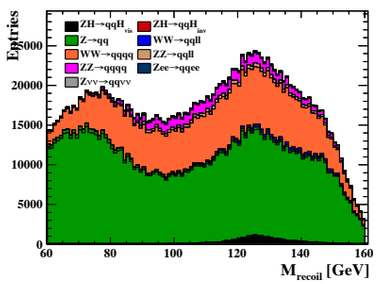


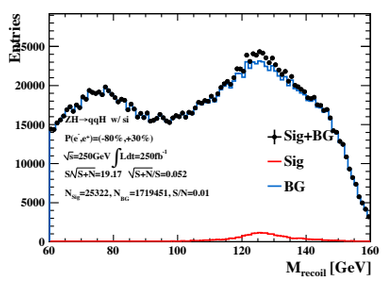
3.1 Si qqH 250GeV

$\sqrt{s}$=250GeV, L=250fb^{-1}, P(e^-, e^+) = P($-0.8, +0.3$).
- Signal is full reconstructed with SiECAL.
- Sig data (raw data) is 25K events. - BG data (raw data) is DST sample.

Process	$\sigma \cdot L$	$\epsilon^{vis}_{pre-sel}$	$\epsilon^{vis}_{all-sel}$	$N^{vis}_{all-sel}$	$\epsilon^{inv}_{all-sel}$	$N^{inv}_{all-sel}$	$\epsilon^{vis+inv}$
ZH	53059 (norm)	-%	47.8%	25322 (norm)	51.6%	-	-
$H \to b\bar{b}$	14198 (raw)	-%	47.9%	6810 (raw)	0.0%	-	47.9%
$H \to c\bar{c}$	708 (raw)	-%	50.5%	358 (raw)	0.0%	-	50.5%
$H \to s\bar{s}$	8 (raw)	-%	62.5%	5 (raw)	0.0%	-	62.5%
$H \to gluglu$	1683 (raw)	-%	48.8%	822 (raw)	0.0%	-	48.8%
$H \to \gamma\gamma$	75 (raw)	-%	48.0%	36 (raw)	0.0%	-	48.0%
$H \to \tau\tau$	1827 (raw)	-%	41.6%	760 (raw)	0.5%	10 (raw)	42.1%
$H \to \mu\mu$	12 (raw)	-%	41.7%	5 (raw)	0.0%	-	40.0%
$H \to WW^* \to qqqq$	2586 (raw)	-%	50.7%	1311 (raw)	0.0%	-	50.7%
$H \to WW^* \to qqll$	2565 (raw)	-%	47.3%	1213 (raw)	0.0%	-	47.3%
$H \to WW^* \to llll$	600 (raw)	-%	46.8%	281 (raw)	0.2%	1 (raw)	47.0%
$H \to \gamma Z$	55 (raw)	-%	50.9%	28 (raw)	0.0%	-	50.9%
$H \to ZZ^* \to qqqq$	364 (raw)	-%	50.5%	184 (raw)	0.0%	-	50.5%
$H \to ZZ^* \to qqll$	262 (raw)	-%	50.0%	131 (raw)	0.7%	2 (raw)	50.7%
$H \to ZZ^* \to llll$	57 (raw)	-%	24.6%	14 (raw)	22.0%	7 (raw)	46.6%
$H \to$ invisible	-	-%	0.3%	-	51.6%	-	51.6%
$Z \to qq$	2.0×10^7 (norm)	-%	5.5%	1.1×10^6 (norm)	<0.1%	0	-
$ZZ \to qqqq$	2.1×10^5 (norm)	-%	35.2%	74428 (norm)	0.0%	2312	-
$ZZ \to qqll$	2.1×10^5 (norm)	-%	12.8%	27308 (norm)	2.4%	5410 (norm)	-
$WW \to qqqq$	2.2×10^6 (norm)	-%	23.2%	496872 (norm)	0.0%	0	-
$WW \to qqll$	2.0×10^5 (norm)	-%	8.7%	18082 (norm)	0.42%	867 (norm)	-
$Zvv \to qqvv$	6.8×10^4 (norm)	-%	1.53%	1033 (norm)	12.4%	9651 (norm)	-
$Zee \to qqee$	7.0×10^4 (norm)	-%	15.7%	11866 (norm)	0.0%	0	-

- Count the number of events. $\to \Delta\sigma_{HZ}/\sigma_{HZ} = \sqrt{S_{vis} + N_{(vis+inv)}}/S_{vis} = \pm 5.3\%$ ($q\bar{q}$ channnel).



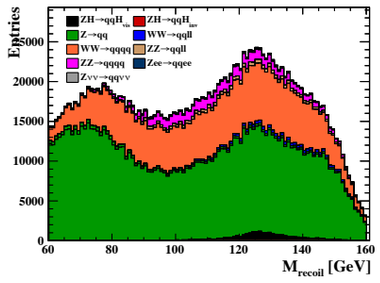


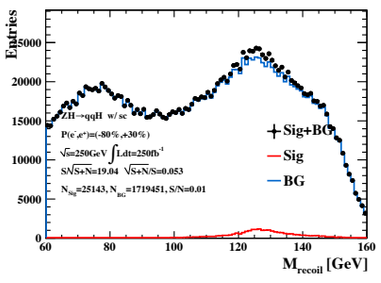
3.2 Sc qqH 250GeV

$\sqrt{s}$=250GeV, L=250fb^{-1}, P(e^-, e^+) = P($-0.8, +0.3$).
Signal is full reconstructed with ScECAL.
- Sig data (raw data) is 25K events. - BG data (raw data) is DST sample.

Process	$\sigma \cdot L$	$\epsilon^{vis}_{pre-sel}$	$\epsilon^{vis}_{all-sel}$	$N^{vis}_{all-sel}$	$\epsilon^{inv}_{all-sel}$	$N^{inv}_{all-sel}$	$\epsilon^{vis+inv}$
ZH	53059 (norm)	-%	47.5%	25143 (norm)	51.6%	-	-
$H \to b\bar{b}$	14198 (raw)	-%	48.0%	6822 (raw)	0.0%	-	48.0%
$H \to c\bar{c}$	708 (raw)	-%	52.6%	373 (raw)	0.0%	-	52.6%
$H \to s\bar{s}$	8 (raw)	-%	62.5%	5 (raw)	0.0%	-	62.5%
$H \to gluglu$	1683 (raw)	-%	45.2%	760 (raw)	0.0%	-	45.2%
$H \to \gamma\gamma$	75 (raw)	-%	48.5%	34 (raw)	0.0%	-	48.5%
$H \to \tau\tau$	1827 (raw)	-%	41.0%	747 (raw)	0.55%	10 (raw)	42.0%
$H \to \mu\mu$	12 (raw)	-%	25.0%	3 (raw)	0.0%	-	25.0%
$H \to WW^* \to qqqq$	2586 (raw)	-%	50.7%	1313 (raw)	0.0%	-	50.7%
$H \to WW^* \to qqll$	2565 (raw)	-%	47.4%	1216 (raw)	0.0%	-	47.4%
$H \to WW^* \to llll$	600 (raw)	-%	43.8%	263 (raw)	0.5%	3 (raw)	44.3%
$H \to \gamma Z$	55 (raw)	-%	52.7%	29 (raw)	0.0%	-	52.7%
$H \to ZZ^* \to qqqq$	364 (raw)	-%	50.3%	183 (raw)	0.0%	-	50.3%
$H \to ZZ^* \to qqll$	262 (raw)	-%	43.5%	114 (raw)	0.4%	1 (raw)	43.9%
$H \to ZZ^* \to llll$	57 (raw)	-%	21.1%	12 (raw)	21.1%	12 (raw)	42.2%
$H \to$ invisible	-	-%	0.16%	-	50.7%	-	50.9%
$Z \to qq$	2.0×10^7 (norm)	-%	5.5%	1.1×10^6 (norm)	<0.1%	0	-
$ZZ \to qqqq$	2.1×10^5 (norm)	-%	35.2%	74428 (norm)	0.0%	2312	-
$ZZ \to qqll$	2.1×10^5 (norm)	-%	12.8%	27308 (norm)	2.4%	5410 (norm)	-
$WW \to qqqq$	2.2×10^6 (norm)	-%	23.2%	496872 (norm)	0.0%	0	-
$WW \to qqll$	2.0×10^5 (norm)	-%	8.7%	18082 (norm)	0.42%	867 (norm)	-
$Zvv \to qqvv$	6.8×10^4 (norm)	-%	1.53%	1033 (norm)	12.4%	9651 (norm)	-
$Zee \to qqee$	7.0×10^4 (norm)	-%	15.7%	11866 (norm)	0.0%	0	-

- Count the number of events. $\to \Delta\sigma_{HZ}/\sigma_{HZ} = \sqrt{S_{vis} + N_{(vis+inv)}}/S_{vis} \sim \pm 5.3\%$ ($q\bar{q}$ channnel).





Back up Slides

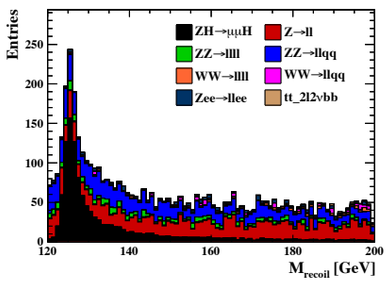
Summary of Recoil Mass@ 350GeV, P(-0.8, +0.3) Cut Base Selection

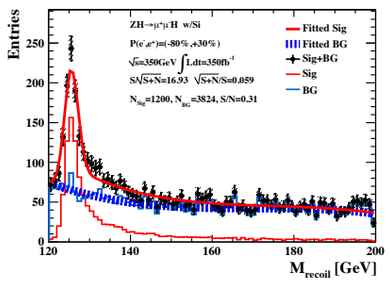
4.1 Si $\mu\mu$H 350GeV

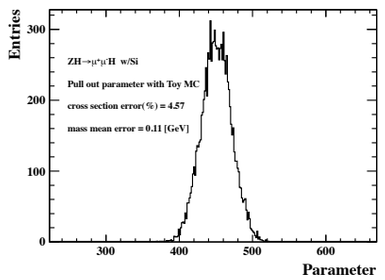
- $\sqrt{s}$=350GeV, L=350fb^{-1}, P(e^-, e^+) = P$(-0.8, +0.3)$.
- Signal is full reconstructed with SiECAL.
- Sig data (raw data) is 25K events. - BG data (raw data) is DST sample.

Process	$\sigma \cdot L$	$\epsilon^{vis}_{all-sel}$	$N^{vis}_{all-sel}$	$\epsilon^{inv}_{all-sel}$	$N^{inv}_{all-sel}$	$\epsilon^{vis+inv}$
ZH	2388 (norm)	50.3%	1200 (norm)	-%	-	-
$H \to b\bar{b}$	14163 (raw)	51.2 %	7250 (raw)	-%	-	-%
$H \to c\bar{c}$	723 (raw)	51.6 %	373 (raw)	-%	-	-%
~~$H \to s\bar{s}$~~	~~8 (raw)~~	~~50.0 %~~	~~4 (raw)~~	-%	-	-%
$H \to gluglu$	1701 (raw)	49.4 %	840 (raw)	-%	-	-%
$H \to \tau\tau$	1879 (raw)	51.11 %	960 (raw)	-%	-	-%
~~$H \to \mu\mu$~~	~~4 (raw)~~	~~25.0 %~~	~~1 (raw)~~	-%	-	-%
~~$H \to \gamma\gamma$~~	~~61 (raw)~~	~~54.1 %~~	~~33 (raw)~~	-%	-	-%
~~$H \to \gamma Z$~~	~~48 (raw)~~	~~45.8 %~~	~~22 (raw)~~	-%	-	-%
$H \to WW^*$	5704 (raw)	50.1 %	2858 (raw)	-%	-	-%
$H \to WW^* \to qqqq$	2650 (raw)	49.2 %	1305 (raw)	-%	-	-%
$H \to WW^* \to qqll$	2442 (raw)	51.4 %	1255 (raw)	-%	-	-%
$H \to WW^* \to llll$	612 (raw)	48.7 %	298 (raw)	-%	-	-%
$H \to ZZ^*$	708 (raw)	50.0 %	354 (raw)	-%	-	-%
$H \to ZZ^* \to qqqq$	320 (raw)	49.7 %	159 (raw)	-%	-	-%
$H \to ZZ^* \to qqll$	313 (raw)	50.8 %	159 (raw)	-%	-	-%
~~$H \to ZZ^* \to llll$~~	~~75 (raw)~~	~~48.0 %~~	~~36 (raw)~~	-%	-	-%
$H \to$ invisible	-	-%	-	-%	-	-%
$Z \to ll$	2.3×10^6 (norm)	<0.1%	1653 (norm)	-%	-	-
$ZZ \to llll$	2.0×10^4 (norm)	1.49%	345 (norm)	-%	-	-
$ZZ \to qqll$	2.0×10^5 (norm)	0.66%	1422 (norm)	-%	-	-
$WW \to llll$	2.4×10^5 (norm)	<0.1%	101 (norm)	-%	-	-
$WW \to qqll$	2.9×10^6 (norm)	<0.1%	110 (norm)	-%	-	-
$Zee \to llee$	2.6×10^5 (norm)	<0.1%	170 (norm)	-%	-	-
$t\bar{t} \to qqqqlv$	2.6×10^4 (norm)	<0.1%	22 (norm)	-%	-	-

- Count the number of events. $\to \Delta\sigma_{HZ}/\sigma_{HZ} = \sqrt{S_{vis} + N_{(vis)}}/S_{vis} = \pm 5.9\%$ ($\mu\mu$ channnel).
- Toy MC. $\to \Delta\sigma_{HZ}/\sigma_{HZ} = \pm 4.6\%$ ($\mu\mu$ channnel).





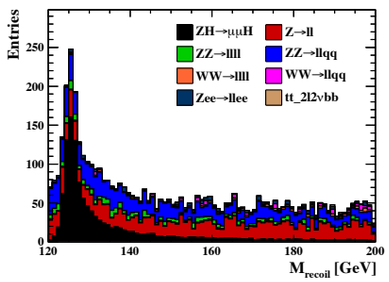


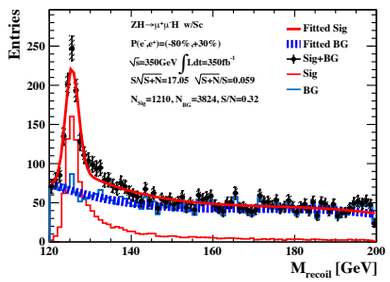
4.2 Sc $\mu\mu$H 350GeV

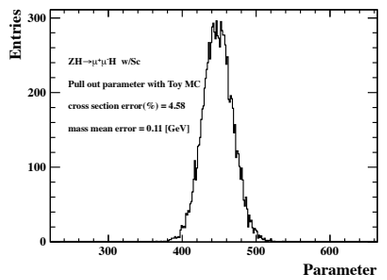
- $\sqrt{s}$=350GeV, L=350fb^{-1}, P(e^-, e^+) = P$(-0.8, +0.3)$.
- Signal is full reconstructed with ScECAL.
- Sig data (raw data) is 25K events. - BG data (raw data) is DST sample.

Process	$\sigma \cdot L$	$\epsilon^{vis}_{all-sel}$	$N^{vis}_{all-sel}$	$\epsilon^{inv}_{all-sel}$	$N^{inv}_{all-sel}$	$\epsilon^{vis+inv}$
ZH	2388 (norm)	50.3%	1210 (norm)	-%	-	-
$H \to b\bar{b}$	14163 (raw)	51.2 %	7246 (raw)	-%	-	-%
$H \to c\bar{c}$	723 (raw)	51.4 %	372 (raw)	-%	-	-%
~~$H \to s\bar{s}$~~	~~8 (raw)~~	~~50.0 %~~	~~4 (raw)~~	-%	-	-%
$H \to gluglu$	1701 (raw)	49.6 %	844 (raw)	-%	-	-%
$H \to \tau\tau$	1879 (raw)	50.9 %	957 (raw)	-%	-	-%
~~$H \to \mu\mu$~~	~~4 (raw)~~	~~25.0 %~~	~~1 (raw)~~	-%	-	-%
~~$H \to \gamma\gamma$~~	~~61 (raw)~~	~~62.3 %~~	~~38 (raw)~~	-%	-	-%
~~$H \to \gamma Z$~~	~~48 (raw)~~	~~47.9 %~~	~~23 (raw)~~	-%	-	-%
$H \to WW^*$	5704 (raw)	50.5 %	2879 (raw)	-%	-	-%
$H \to WW^* \to qqqq$	2650 (raw)	50.0 %	1325 (raw)	-%	-	-%
$H \to WW^* \to qqll$	2442 (raw)	51.4 %	1255 (raw)	-%	-	-%
$H \to WW^* \to llll$	612 (raw)	48.9 %	299 (raw)	-%	-	-%
$H \to ZZ^*$	708 (raw)	49.3 %	349 (raw)	-%	-	-%
$H \to ZZ^* \to qqqq$	320 (raw)	48.8 %	156 (raw)	-%	-	-%
$H \to ZZ^* \to qqll$	313 (raw)	50.5 %	158 (raw)	-%	-	-%
~~$H \to ZZ^* \to llll$~~	~~75 (raw)~~	~~46.7 %~~	~~35 (raw)~~	-%	-	-%
$H \to$ invisible	-	-%	-	-%	-	-%
$Z \to ll$	2.3×10^6 (norm)	<0.1%	1653 (norm)	-%	-	-
$ZZ \to llll$	2.0×10^4 (norm)	1.49%	345 (norm)	-%	-	-
$ZZ \to qqll$	2.0×10^5 (norm)	0.66%	1422 (norm)	-%	-	-
$WW \to llll$	2.4×10^5 (norm)	<0.1%	101 (norm)	-%	-	-
$WW \to qqll$	2.9×10^6 (norm)	<0.1%	110 (norm)	-%	-	-
$Zee \to llee$	2.6×10^5 (norm)	<0.1%	170 (norm)	-%	-	-
$t\bar{t} \to qqqqlv$	2.6×10^4 (norm)	<0.1%	22 (norm)	-%	-	-

- Count the number of events. $\to \Delta\sigma_{HZ}/\sigma_{HZ} = \sqrt{S_{vis} + N_{(vis)}}/S_{vis} = \pm 5.9\%$ ($\mu\mu$ channnel).
- Toy MC. $\to \Delta\sigma_{HZ}/\sigma_{HZ} = \pm 4.6\%$ ($\mu\mu$ channnel).





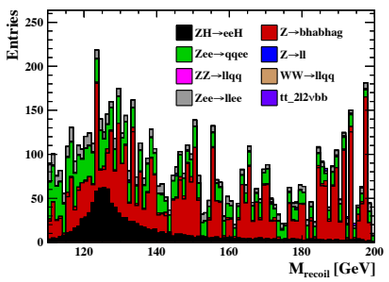


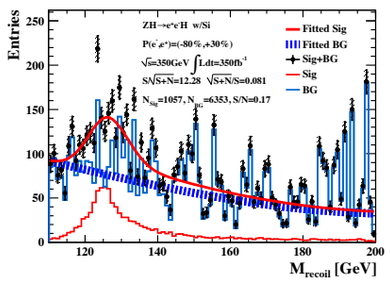
5.1 Si eeH 350GeV

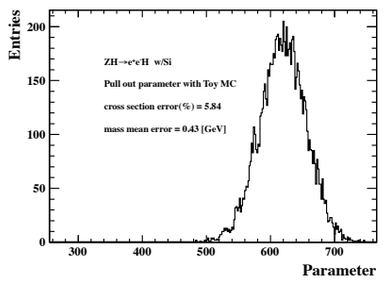
- $\sqrt{s}$=350GeV, L=350fb^{-1}, P(e^-, e^+) = P$(-0.8, +0.3)$.
- Signal is full reconstructed with SiECAL.
- Sig data (raw data) is 25K events. - BG data (raw data) is DST sample.

Process	$\sigma \cdot L$	$\epsilon^{vis}_{all-sel}$	$N^{vis}_{all-sel}$	$\epsilon^{inv}_{all-sel}$	$N^{inv}_{all-sel}$	$\epsilon^{vis+inv}$
ZH	3579 (norm)	29.6%	1057 (norm)	-%	-	-
$H \to b\bar{b}$	14033 (raw)	31.2 %	4380 (raw)	-%	-	-%
$H \to c\bar{c}$	696 (raw)	31.8 %	221 (raw)	-%	-	-%
$H \to s\bar{s}$	8 (raw)	12.5 %	1 (raw)	-%	-	-%
$H \to gluglu$	1670 (raw)	32.8 %	548 (raw)	-%	-	-%
$H \to \tau\tau$	1919 (raw)	30.5 %	586 (raw)	-%	-	-%
$H \to \mu\mu$	4 (raw)	50.0 %	2 (raw)	%		%
$H \to \gamma\gamma$	92 (raw)	23.9 %	22 (raw)	%		%
$H \to \gamma Z$	44 (raw)	27.3 %	12 (raw)	-%	-	-%
$H \to WW^*$	5735 (raw)	31.3 %	1796 (raw)	-%	-	-%
$H \to WW^* \to qqqq$	2619 (raw)	31.2 %	816 (raw)	-%	-	-%
$H \to WW^* \to qqll$	2515 (raw)	31.3 %	786 (raw)	-%	-	-%
$H \to WW^* \to llll$	601 (raw)	32.3 %	194 (raw)	-%	-	-%
$H \to ZZ^*$	724 (raw)	28.2 %	204 (raw)	-%	-	-%
$H \to ZZ^* \to qqqq$	367 (raw)	31.1 %	114 (raw)	-%	-	-%
$H \to ZZ^* \to qqll$	303 (raw)	25.2 %	77 (raw)	-%	-	-%
$H \to ZZ^* \to llll$	54 (raw)	24.1 %	13 (raw)	-%	-	-%
$H \to$ invisible	-	-%	-	-%	-	-%
$ee \to ee(\gamma)$	6.0×10^6 (norm)	<0.1%	3824 (norm)	-%	-	-
$Z \to ll$	2.3×10^6 (norm)	<0.1%	1653 (norm)	-%	-	-
$ZZ \to llll$	2.0×10^4 (norm)	1.49%	345 (norm)	-%	-	-
$ZZ \to qqll$	2.0×10^5 (norm)	0.66%	1422 (norm)	-%	-	-
$WW \to llll$	2.4×10^5 (norm)	<0.1%	101 (norm)	-%	-	-
$WW \to qqll$	2.9×10^6 (norm)	<0.1%	110 (norm)	-%	-	-
$Zee \to qqee$	1.1×10^5 (norm)	1.4%	1852 (norm)	-%	-	-
$Zee \to llee$	2.6×10^5 (norm)	<0.1%	170 (norm)	-%	-	-
$t\bar{t} \to qqqqlv$	2.6×10^4 (norm)	<0.1%	22 (norm)	-%	-	-

- Count the number of events. $\to \Delta\sigma_{HZ}/\sigma_{HZ} = \sqrt{S_{vis} + N_{(vis)}}/S_{vis} = \pm 8.1\%$ (ee channnel).
- Toy MC. $\to \Delta\sigma_{HZ}/\sigma_{HZ} = \pm 6.0\%$ (ee channnel).





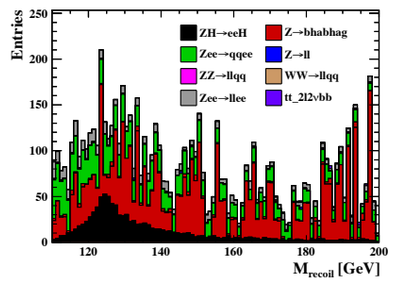


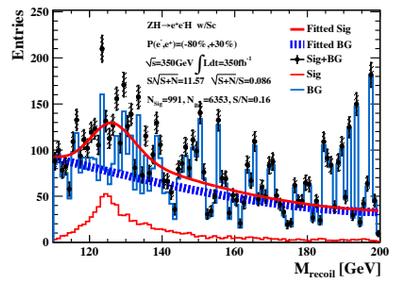
5.2 Sc eeH 350GeV

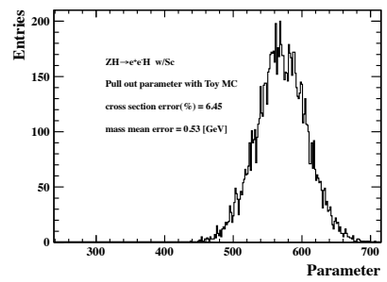
- $\sqrt{s}$=350GeV, L=350fb^{-1}, P(e^-, e^+) = P$(-0.8, +0.3)$.
- Signal is full reconstructed with ScECAL.
- Sig data (raw data) is 25K events. - BG data (raw data) is DST sample.

Process	$\sigma \cdot L$	$\epsilon^{vis}_{all-sel}$	$N^{vis}_{all-sel}$	$\epsilon^{inv}_{all-sel}$	$N^{inv}_{all-sel}$	$\epsilon^{vis+inv}$
ZH	3579 (norm)	27.7%	992 (norm)	-%	-	-
$H \to b\bar{b}$	14074 (raw)	29.8 %	4198 (raw)	-%	-	-%
$H \to c\bar{c}$	699 (raw)	31.1 %	217 (raw)	-%	-	-%
$H \to s\bar{s}$	8 (raw)	12.5 %	1 (raw)	-%	-	-%
$H \to gluglu$	1674 (raw)	29.5 %	494 (raw)	-%	-	-%
$H \to \tau\tau$	1922 (raw)	30.4 %	585 (raw)	-%	-	-%
$H \to \mu\mu$	4 (raw)	50.0 %	2 (raw)	-%	-	-%
$H \to \gamma\gamma$	92 (raw)	20.7 %	19 (raw)	-%	-	-%
$H \to \gamma Z$	45 (raw)	26.7 %	12 (raw)	-%	-	-%
$H \to WW^*$	5755 (raw)	29.3 %	1685 (raw)	-%	-	-%
$H \to WW^* \to qqqq$	2628 (raw)	29.0 %	763 (raw)	-%	-	-%
$H \to WW^* \to qqll$	2526 (raw)	29.3 %	739 (raw)	-%	-	-%
$H \to WW^* \to llll$	601 (raw)	30.4 %	183 (raw)	-%	-	-%
$H \to ZZ^*$	727 (raw)	28.6 %	208 (raw)	-%	-	-%
$H \to ZZ^* \to qqqq$	368 (raw)	31.8 %	117 (raw)	-%	-	-%
$H \to ZZ^* \to qqll$	305 (raw)	25.6 %	78 (raw)	-%	-	-%
$H \to ZZ^* \to llll$	54 (raw)	24.1 %	13 (raw)	-%	-	-%
$H \to$ invisible	-	-%	-	-%	-	-%
$ee \to ee(\gamma)$	6.0×10^6 (norm)	<0.1%	3824 (norm)	-%	-	-
$Z \to ll$	2.3×10^6 (norm)	<0.1%	1653 (norm)	-%	-	-
$ZZ \to llll$	2.0×10^4 (norm)	1.49%	345 (norm)	-%	-	-
$ZZ \to qqll$	2.0×10^5 (norm)	0.66%	1422 (norm)	-%	-	-
$WW \to llll$	2.4×10^5 (norm)	<0.1%	101 (norm)	-%	-	-
$WW \to qqll$	2.9×10^6 (norm)	<0.1%	110 (norm)	-%	-	-
$Zee \to qqee$	1.1×10^5 (norm)	1.4%	1852 (norm)	-%	-	-
$Zee \to llee$	2.6×10^5 (norm)	<0.1%	170 (norm)	-%	-	-
$t\bar{t} \to qqqqlv$	2.6×10^4 (norm)	<0.1%	22 (norm)	-%	-	-

- Count the number of events. $\to \Delta\sigma_{HZ}/\sigma_{HZ} = \sqrt{S_{vis} + N_{(vis)}}/S_{vis} = \pm 8.6\%$ (ee channnel).
- Toy MC. $\to \Delta\sigma_{HZ}/\sigma_{HZ} = \pm 6.5\%$ (ee channnel).





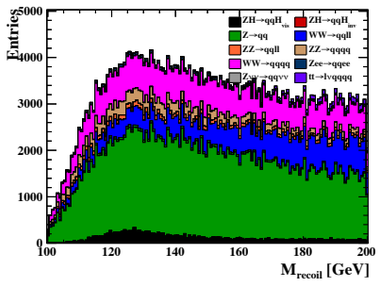


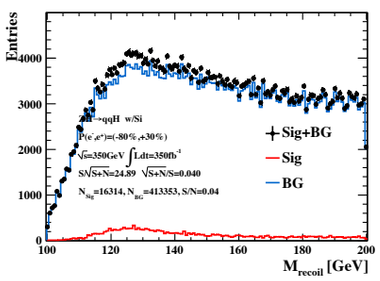
6.1 Si qqH 350GeV

$\sqrt{s}$=350GeV, L=350fb^{-1}, P(e^-, e^+) = P$(-0.8, +0.3)$.
Signal is full reconstructed with SiECAL.
- Sig data (raw data) is 25K events. - BG data (raw data) is DST sample.

Process	$\sigma \cdot L$	$\epsilon^{vis}_{pre-sel}$	$\epsilon^{vis}_{all-sel}$	$N^{vis}_{all-sel}$	$\epsilon^{inv}_{all-sel}$	$N^{inv}_{all-sel}$	$\epsilon^{vis+inv}$
ZH	49926 (norm)	73.2%	32.7%	16314 (norm)	29.2%	-	-
$H \to b\bar{b}$	14300 (raw)	76.7%	35.8%	5127 (raw)	0.0%	-	35.8%
$H \to c\bar{c}$	677 (raw)	70.9%	30.7%	208 (raw)	0.0%	-	30.7%
$H \to s\bar{s}$	~~7 (raw)~~	~~71.4%~~	~~28.6%~~	~~2 (raw)~~	~~0.0%~~	-	~~28.6%~~
$H \to gluglu$	1752 (raw)	64.5%	27.3%	478 (raw)	0.0%	-	27.3%
$H \to \gamma\gamma$	~~73 (raw)~~	~~61.6%~~	~~31.5%~~	~~23 (raw)~~	~~0.0%~~	-	~~31.5%~~
$H \to \tau\tau$	1809 (raw)	62.7%	26.3%	470 (raw)	0.1%	2 (raw)	26.4%
$H \to \mu\mu$	~~5 (raw)~~	~~40.0%~~	~~40.0%~~	~~2 (raw)~~	~~0.0%~~	-	~~40.0%~~
$H \to WW^* \to qqqq$	2517 (raw)	68.9%	28.2%	709 (raw)	0.0%	-	28.2%
$H \to WW^* \to qqll$	2517 (raw)	71.5%	29.7%	747 (raw)	0.0%	-	29.7%
$H \to WW^* \to llll$	617 (raw)	78.4%	29.8%	184 (raw)	0.3%	2 (raw)	30.1%
$H \to \gamma Z$	~~36 (raw)~~	~~63.9%~~	~~22.2%~~	~~8 (raw)~~	~~0.0%~~	-	~~22.2%~~
$H \to ZZ^* \to qqqq$	340 (raw)	74.1%	29.4%	100 (raw)	0.0%	-	29.4%
$H \to ZZ^* \to qqll$	289 (raw)	71.9%	31.8%	92 (raw)	0.0%	-	31.8%
$H \to ZZ^* \to llll$	~~61 (raw)~~	~~63.9%~~	~~21.3%~~	~~13 (raw)~~	~~11.4%~~	~~7 (raw)~~	~~32.7%~~
$H \to$ invisible	-	53.6%	0.5%	-	29.2%	-	29.7%
$Z \to qq$	1.4×10^7 (norm)	-%	2.1%	2.3×10^5 (norm)	0.0%	0	-
$ZZ \to qqqq$	2.1×10^5 (norm)	42.2%	11.1%	24495 (norm)	0.0%	0	-
$ZZ \to qqll$	2.0×10^5 (norm)	49.9%	4.8%	9393 (norm)	1.6%	3502 (norm)	-
$WW \to qqqq$	2.2×10^6 (norm)	23.3%	3.4%	78981 (norm)	0.0%	0	-
$WW \to qqll$	2.9×10^6 (norm)	30.5%	2.2%	6353 (norm)	0.2%	4059 (norm)	-
$Zvv \to qqvv$	1.2×10^5 (norm)	62.4%	3.5%	869 (norm)	5.4%	7124 (norm)	-
$Zee \to qqee$	1.0×10^5 (norm)	44.3%	4.4%	5464 (norm)	0.0%	0	-
$t\bar{t} \to qqqqlv$	2.6×10^4 (norm)	84.9%	18.0%	4814 (norm)	0.0%	0	-

- Count the number of events. $\to \Delta\sigma_{HZ}/\sigma_{HZ} = \sqrt{S_{vis} + N_{(vis+inv)}}/S_{vis} = \pm 4.0\%$ (q$\bar{\text{q}}$ channnel).



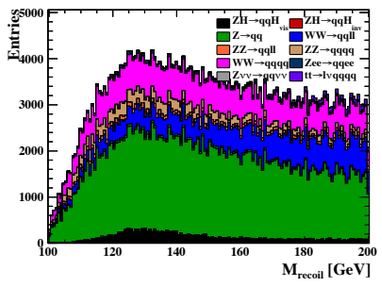


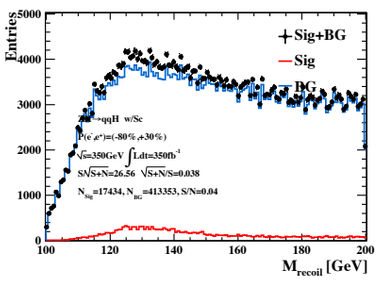
6.2 Sc qqH 350GeV

$\sqrt{s}$=350GeV, L=350fb^{-1}, P(e^-, e^+) = P$(-0.8, +0.3)$.
Signal is full reconstructed with ScECAL.
- Sig data (raw data) is 25K events. - BG data (raw data) is DST sample.

Process	$\sigma \cdot L$	$\epsilon^{vis}_{pre-sel}$	$\epsilon^{vis}_{all-sel}$	$N^{vis}_{all-sel}$	$\epsilon^{inv}_{all-sel}$	$N^{inv}_{all-sel}$	$\epsilon^{vis+inv}$
ZH	49926 (norm)	77.1%	34.9%	17434 (norm)	30.8%	-	-
$H \to b\bar{b}$	14300 (raw)	81.3%	38.2%	5461 (raw)	0.0%	-	38.2%
$H \to c\bar{c}$	677 (raw)	79.0%	34.4%	233 (raw)	0.0%	-	34.4%
$H \to s\bar{s}$	~~7 (raw)~~	~~85.7%~~	~~14.3%~~	~~1 (raw)~~	~~0.0%~~	-	~~14.3%~~
$H \to gluglu$	1752 (raw)	70.7%	31.8%	557 (raw)	0.0%	-	31.8%
$H \to \gamma\gamma$	~~73 (raw)~~	~~75.3%~~	~~35.6%~~	~~10 (raw)~~	~~0.0%~~	-	~~35.6%~~
$H \to \tau\tau$	1809 (raw)	60.5%	24.9%	450 (raw)	0.2%	3 (raw)	25.1%
$H \to \mu\mu$	~~5 (raw)~~	~~80.0%~~	~~60.0%~~	~~3 (raw)~~	~~0.0%~~	-	~~60.0%~~
$H \to WW^* \to qqqq$	2517 (raw)	77.1%	33.1%	834 (raw)	0.0%	-	33.1%
$H \to WW^* \to qqll$	2517 (raw)	70.3%	31.2%	786 (raw)	0.0%	-	31.2%
$H \to WW^* \to llll$	617 (raw)	75.0%	25.8%	159 (raw)	0.3%	2 (raw)	26.1%
$H \to \gamma Z$	~~36 (raw)~~	~~80.5%~~	~~27.8%~~	~~10 (raw)~~	~~0.0%~~	-	~~27.8%~~
$H \to ZZ^* \to qqqq$	340 (raw)	80.6%	34.1%	116 (raw)	0.0%	-	34.1%
$H \to ZZ^* \to qqll$	289 (raw)	68.5%	28.4%	82 (raw)	0.0%	-	28.4%
$H \to ZZ^* \to llll$	~~61 (raw)~~	~~64.0%~~	~~19.7%~~	~~12 (raw)~~	~~11.4%~~	~~7 (raw)~~	~~31.1%~~
$H \to$ invisible	-	62.3%	0.6%	-	30.8%	-	31.4%
$Z \to qq$	1.4×10^7 (norm)	-%	2.1%	2.3×10^5 (norm)	0.0%	0	-
$ZZ \to qqqq$	2.1×10^5 (norm)	42.2%	11.1%	24495 (norm)	0.0%	0	-
$ZZ \to qqll$	2.0×10^5 (norm)	49.9%	4.8%	9393 (norm)	1.6%	3502 (norm)	-
$WW \to qqqq$	2.2×10^6 (norm)	23.3%	3.4%	78981 (norm)	0.0%	0	-
$WW \to qqll$	2.9×10^6 (norm)	30.5%	2.2%	6353 (norm)	0.2%	4059 (norm)	-
$Zvv \to qqvv$	1.2×10^5 (norm)	62.4%	3.5%	869 (norm)	5.4%	7124 (norm)	-
$Zee \to qqee$	1.0×10^5 (norm)	44.3%	4.4%	5464 (norm)	0.0%	0	-
$t\bar{t} \to qqqqlv$	2.6×10^4 (norm)	84.9%	18.0%	4814 (norm)	0.0%	0	-

- Count the number of events. $\to \Delta\sigma_{HZ}/\sigma_{HZ} = \sqrt{S_{vis} + N_{(vis+inv)}}/S_{vis} = \pm ??\%$ (q$\bar{\text{q}}$ channnel).





Back up Slides

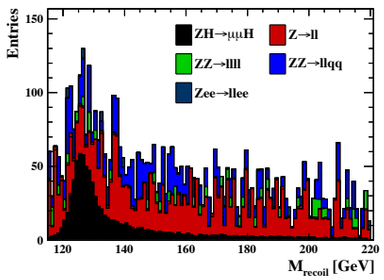
Summary of Recoil Mass@ 500GeV, P(-0.8, +0.3) Cut Base Selection

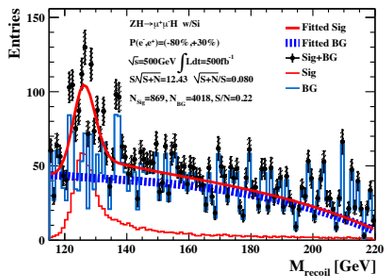
8.1 Si $\mu\mu$H 500GeV

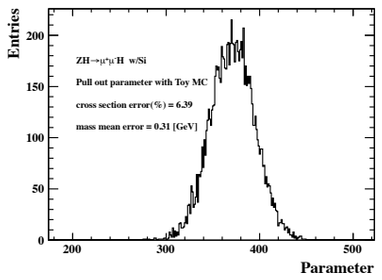
- $\sqrt{s}$=500GeV, L=500fb^{-1}, P(e^-, e^+) = P$(-0.8, +0.3)$.
- Signal is full reconstructed with SiECAL.
- Sig data (raw data) is 25K events. - BG data (raw data) is DST sample.

Process	$\sigma \cdot L$	$\epsilon^{vis}_{all-sel}$	$N^{vis}_{all-sel}$	$\epsilon^{inv}_{all-sel}$	$N^{inv}_{all-sel}$	$\epsilon^{vis+inv}$
ZH	1652 (norm)	52.6%	869 (norm)	-%	-	-
$H \to b\bar{b}$	14188 (raw)	52.5 %	7451 (raw)	-%	-	-%
$H \to c\bar{c}$	712 (raw)	52.4 %	373 (raw)	-%	-	-%
$H \to s\bar{s}$	10 (raw)	40.0 %	4 (raw)	-%	-	-%
$H \to gluglu$	1686 (raw)	50.6 %	853 (raw)	-%	-	-%
$H \to \tau\tau$	1961 (raw)	54.6 %	1071 (raw)	-%	-	-%
$H \to \mu\mu$	8 (raw)	12.5 %	1 (raw)	-%	-	-%
$H \to \gamma\gamma$	81 (raw)	56.8 %	46 (raw)	-%	-	-%
$H \to \gamma Z$	41 (raw)	56.1 %	23 (raw)	-%	-	-%
$H \to WW^*$	5589 (raw)	52.7 %	2947 (raw)	-%	-	-%
$H \to WW^* \to qqqq$	2612 (raw)	53.7 %	1405 (raw)	-%	-	-%
$H \to WW^* \to qqll$	2461 (raw)	52.2 %	1284 (raw)	-%	-	-%
$H \to WW^* \to llll$	516 (raw)	50,0 %	258 (raw)	-%	-	-%
$H \to ZZ^*$	724 (raw)	52.1 %	377 (raw)	-%	-	-%
$H \to ZZ^* \to qqqq$	361 (raw)	52.9 %	191 (raw)	-%	-	-%
$H \to ZZ^* \to qqll$	303 (raw)	50.2 %	152 (raw)	-%	-	-%
$H \to ZZ^* \to llll$	60 (raw)	56.6 %	34 (raw)	-%	-	-%
$H \to$ invisible	-	-%	-	-%	-	-%
$Z \to ll$	1.7×10^6 (norm)	0.14%	2436 (norm)	-%	-	-
$ZZ \to llll$	1.8×10^4 (norm)	1.4%	283 (norm)	-%	-	-
$ZZ \to qqll$	1.8×10^5 (norm)	0.7%	1252 (norm)	-%	-	-
$WW \to llll$	2.3×10^5 (norm)	0.0%	0 (norm)	-%	-	-
$WW \to qqll$	2.9×10^6 (norm)	0.0%	0 (norm)	-%	-	-
$Zee \to llee$	2.5×10^6 (norm)	<0.1%	47 (norm)	-%	-	-

- Count the number of events. $\to \Delta\sigma_{HZ}/\sigma_{HZ} = \sqrt{S_{vis} + N_{(vis)}}/S_{vis} = \pm 8.0\%$ ($\mu\mu$ channnel).
- Toy MC. $\to \Delta\sigma_{HZ}/\sigma_{HZ} = \pm 6.4\%$ ($\mu\mu$ channnel).





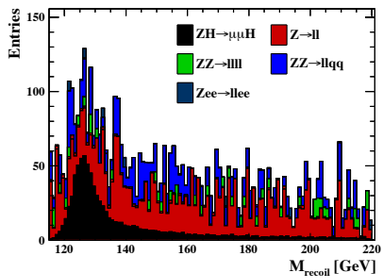


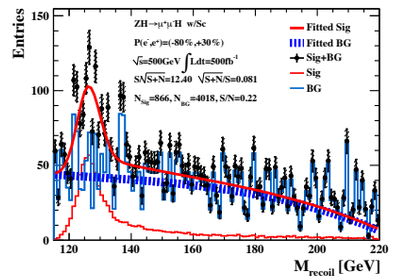
8.2 Sc $\mu\mu$H 500GeV

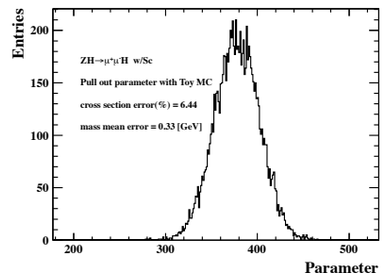
- $\sqrt{s}$=500GeV, L=500fb^{-1}, P(e^-, e^+) = P$(-0.8, +0.3)$.
- Signal is full reconstructed with ScECAL.
- Sig data (raw data) is 25K events. - BG data (raw data) is DST sample.

Process	$\sigma \cdot L$	$\epsilon^{vis}_{all-sel}$	$N^{vis}_{all-sel}$	$\epsilon^{inv}_{all-sel}$	$N^{inv}_{all-sel}$	$\epsilon^{vis+inv}$
ZH	1652 (norm)	52.4%	866 (norm)	-%	-	-
$H \to b\bar{b}$	14188 (raw)	52.5 %	7446 (raw)	-%	-	-%
$H \to c\bar{c}$	712 (raw)	52.4 %	373 (raw)	-%	-	-%
$H \to s\bar{s}$	10 (raw)	30.0 %	3 (raw)	-%	-	-%
$H \to gluglu$	1686 (raw)	50.3 %	848 (raw)	-%	-	-%
$H \to \tau\tau$	1961 (raw)	53.9 %	1058 (raw)	-%	-	-%
$H \to \mu\mu$	8 (raw)	12.5 %	1 (raw)	-%	-	-%
$H \to \gamma\gamma$	81 (raw)	59.3 %	48 (raw)	-%	-	-%
$H \to \gamma Z$	41 (raw)	56.1 %	23 (raw)	-%	-	-%
$H \to WW^*$	5589 (raw)	52.4 %	2931 (raw)	-%	-	-%
$H \to WW^* \to qqqq$	2612 (raw)	53.3 %	1392 (raw)	-%	-	-%
$H \to WW^* \to qqll$	2461 (raw)	52.1 %	1281 (raw)	-%	-	-%
$H \to WW^* \to llll$	516 (raw)	50.0 %	258 (raw)	-%	-	-%
$H \to ZZ^*$	724 (raw)	51.9 %	376 (raw)	-%	-	-%
$H \to ZZ^* \to qqqq$	361 (raw)	52.9 %	191 (raw)	-%	-	-%
$H \to ZZ^* \to qqll$	303 (raw)	50.2 %	152 (raw)	-%	-	-%
$H \to ZZ^* \to llll$	60 (raw)	55.0 %	33 (raw)	-%	-	-%
$H \to$ invisible	-	-%	-	-%	-	-%
$Z \to ll$	1.7×10^6 (norm)	0.14%	2436 (norm)	-%	-	-
$ZZ \to llll$	1.8×10^4 (norm)	1.4%	283 (norm)	-%	-	-
$ZZ \to qqll$	1.8×10^5 (norm)	0.7%	1252 (norm)	-%	-	-
$WW \to llll$	2.3×10^5 (norm)	0.0%	0 (norm)	-%	-	-
$WW \to qqll$	2.9×10^6 (norm)	0.0%	0 (norm)	-%	-	-
$Zee \to llee$	2.5×10^6 (norm)	<0.1%	47 (norm)	-%	-	-

- Count the number of events. $\to \Delta\sigma_{HZ}/\sigma_{HZ} = \sqrt{S_{vis} + N_{(vis)}}/S_{vis} = \pm 8.1\%$ ($\mu\mu$ channnel).
- Toy MC. $\to \Delta\sigma_{HZ}/\sigma_{HZ} = \pm 6.5\%$ ($\mu\mu$ channnel).





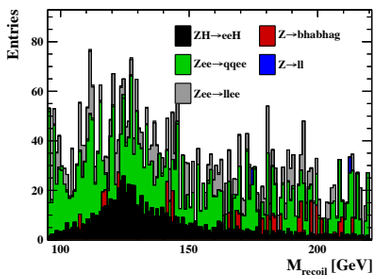


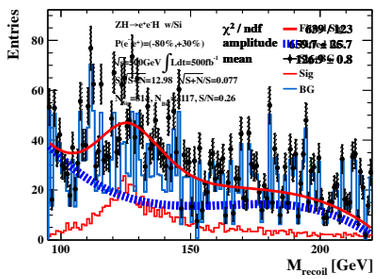
9.1 Si eeH 500GeV

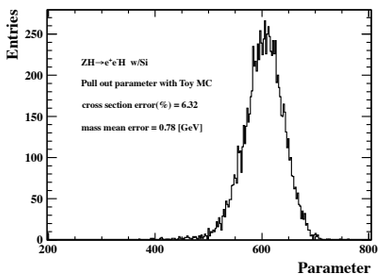
- $\sqrt{s}$=500GeV, L=$500fb^{-1}$, P(e^-, e^+) = P$(-0.8, +0.3)$.
- Signal is full reconstructed with SiECAL.
- Sig data (raw data) is 25K events. - BG data (raw data) is DST sample.

Process	$\sigma \cdot L$	$\epsilon^{vis}_{all-sel}$	$N^{vis}_{all-sel}$	$\epsilon^{inv}_{all-sel}$	$N^{inv}_{all-sel}$	$\epsilon^{vis+inv}$
ZH	5702 (norm)	14.3%	814 (norm)	-%	-	-
$H \to b\bar{b}$	13404 (raw)	14.3 %	1916 (raw)	-%	-	-%
$H \to c\bar{c}$	644 (raw)	11.5 %	74 (raw)	-%	-	-%
$H \to s\bar{s}$	9 (raw)	22.2 %	2 (raw)	-%	-	-%
$H \to gluglu$	1537 (raw)	14.0 %	215 (raw)	-%	-	-%
$H \to \tau\tau$	1797 (raw)	15.1 %	272 (raw)	-%	-	-%
$H \to \mu\mu$	5 (raw)	40.0 %	2 (raw)	-%	-	-%
$H \to \gamma\gamma$	87 (raw)	9.2 %	8 (raw)	-%	-	-%
$H \to \gamma Z$	34 (raw)	17.6 %	6 (raw)	-%	-	-%
$H \to WW^*$	5367 (raw)	14.4 %	772 (raw)	-%	-	-%
$H \to WW^* \to qqqq$	2465 (raw)	14.5 %	358 (raw)	-%	-	-%
$H \to WW^* \to qqll$	2329 (raw)	14.7 %	342 (raw)	-%	-	-%
$H \to WW^* \to llll$	573 (raw)	12.6 %	72 (raw)	-%	-	-%
$H \to ZZ^*$	646 (raw)	14.7 %	95 (raw)	-%	-	-%
$H \to ZZ^* \to qqqq$	329 (raw)	15.2 %	50 (raw)	-%	-	-%
$H \to ZZ^* \to qqll$	254 (raw)	15.4 %	39 (raw)	-%	-	-%
$H \to ZZ^* \to llll$	63 (raw)	9.52 %	6 (raw)	-%	-	-%
$H \to$ invisible	-	-%	-	-%	-	-%
$ee \to ee(\gamma)$	1.1×10^6 (norm)	<0.1%	187 (norm)	-%	-	-
$Z \to ll$	1.7×10^6 (norm)	<0.1%	13 (norm)	-%	-	-
$ZZ \to llll$	1.8×10^4 (norm)	0.0%	0 (norm)	-%	-	-
$ZZ \to qqll$	1.8×10^5 (norm)	0.0%	0 (norm)	-%	-	-
$WW \to llll$	2.3×10^5 (norm)	0.0%	0 (norm)	-%	-	-
$WW \to qqll$	2.9×10^6 (norm)	0.0%	0 (norm)	-%	-	-
$Zee \to qqee$	6.0×10^5 (norm)	0.25%	2005 (norm)	-%	-	-
$Zee \to llee$	2.5×10^6 (norm)	<0.1%	912 (norm)	-%	-	-

- Count the number of events. $\to \Delta\sigma_{HZ}/\sigma_{HZ} = \sqrt{S_{vis} + N_{(vis)}}/S_{vis} = \pm 7.7\%$ (ee channnel).
- Toy MC. $\to \Delta\sigma_{HZ}/\sigma_{HZ} = \pm 6.3\%$ (ee channnel).





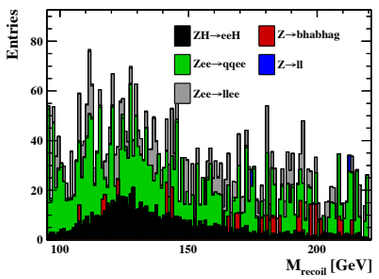


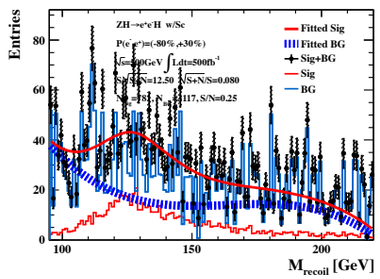
9.2 Sc eeH 500GeV

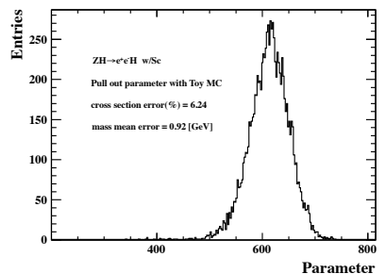
- $\sqrt{s}$=500GeV, L=$500fb^{-1}$, P(e^-, e^+) = P$(-0.8, +0.3)$.
- Signal is full reconstructed with ScECAL.
- Sig data (raw data) is 25K events. - BG data (raw data) is DST sample.

Process	$\sigma \cdot L$	$\epsilon^{vis}_{all-sel}$	$N^{vis}_{all-sel}$	$\epsilon^{inv}_{all-sel}$	$N^{inv}_{all-sel}$	$\epsilon^{vis+inv}$
ZH	5702 (norm)	13.7%	780 (norm)	-%	-	-
$H \to b\bar{b}$	14224 (raw)	13.7 %	1950 (raw)	-%	-	-%
$H \to c\bar{c}$	690 (raw)	11.3 %	78 (raw)	-%	-	-%
$H \to s\bar{s}$	10 (raw)	30.0 %	3 (raw)	-%	-	-%
$H \to gluglu$	1647 (raw)	13.1 %	215 (raw)	-%	-	-%
$H \to \tau\tau$	1913 (raw)	14.2 %	273 (raw)	-%	-	-%
$H \to \mu\mu$	5 (raw)	40.0 %	2 (raw)	-%	-	-%
$H \to \gamma\gamma$	90 (raw)	7.78 %	7 (raw)	-%	-	-%
$H \to \gamma Z$	36 (raw)	11.1 %	4 (raw)	-%	-	-%
$H \to WW^*$	5697 (raw)	14.0 %	798 (raw)	-%	-	-%
$H \to WW^* \to qqqq$	2619 (raw)	14.1 %	370 (raw)	-%	-	-%
$H \to WW^* \to qqll$	2474 (raw)	14.2 %	351 (raw)	-%	-	-%
$H \to WW^* \to llll$	604 (raw)	12.7 %	77 (raw)	-%	-	-%
$H \to ZZ^*$	688 (raw)	13.7 %	94 (raw)	-%	-	-%
$H \to ZZ^* \to qqqq$	346 (raw)	13.1 %	45 (raw)	-%	-	-%
$H \to ZZ^* \to qqll$	273 (raw)	14.7 %	40 (raw)	-%	-	-%
$H \to ZZ^* \to llll$	69 (raw)	13.1 %	9 (raw)	-%	-	-%
$H \to$ invisible	-	-%	-	-%	-	-%
$ee \to ee(\gamma)$	1.1×10^6 (norm)	<0.1%	187 (norm)	-%	-	-
$Z \to ll$	1.7×10^6 (norm)	<0.1%	13 (norm)	-%	-	-
$ZZ \to llll$	1.8×10^4 (norm)	0.0%	0 (norm)	-%	-	-
$ZZ \to qqll$	1.8×10^5 (norm)	0.0%	0 (norm)	-%	-	-
$WW \to llll$	2.3×10^5 (norm)	0.0%	0 (norm)	-%	-	-
$WW \to qqll$	2.9×10^6 (norm)	0.0%	0 (norm)	-%	-	-
$Zee \to qqee$	6.0×10^5 (norm)	0.25%	2005 (norm)	-%	-	-
$Zee \to llee$	2.5×10^6 (norm)	<0.1%	912 (norm)	-%	-	-

- Count the number of events. $\to \Delta\sigma_{HZ}/\sigma_{HZ} = \sqrt{S_{vis} + N_{(vis)}}/S_{vis} = \pm 8.0\%$ (ee channnel).
- Toy MC. $\to \Delta\sigma_{HZ}/\sigma_{HZ} = \pm 6.3\%$ (ee channnel).







Back up Slides

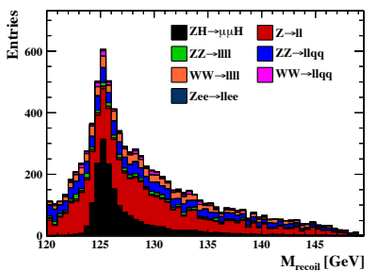
Summary of Recoil Mass@ 250GeV, P(-0.8, +0.3)
MVA Base Selection with SiECAL

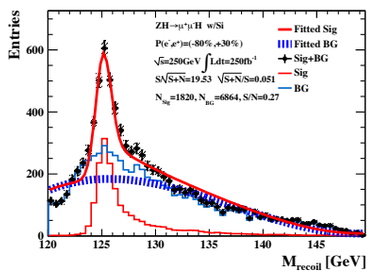
4.1 Si $\mu\mu$H 250GeV

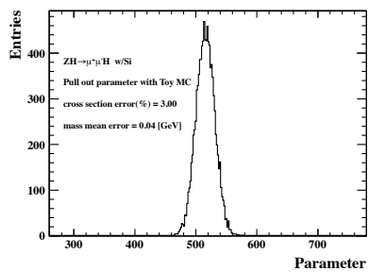
- $\sqrt{s}$=250GeV, L=250fb^{-1}, P(e^-, e^+) = P$(-0.8, +0.3)$.
- Signal is full reconstructed with SiECAL.
- Sig data (raw data) is 25K events. - BG data (raw data) is DST sample.

Process	$\sigma \cdot L$	$\epsilon^{vis}_{all-sel}$	$N^{vis}_{all-sel}$	$\epsilon^{inv}_{all-sel}$	$N^{inv}_{all-sel}$	$\epsilon^{vis+inv}$
ZH	2619 (norm)	69.5%	1820 (norm)	-%	-	-
$H \to b\bar{b}$	14245 (raw)	69.6 %	9918 (raw)	-%	-	-%
$H \to c\bar{c}$	674 (raw)	68.4 %	461 (raw)	-%	-	-%
$H \to s\bar{s}$	6 (raw)	66.7 %	4 (raw)	-%	-	-%
$H \to gluglu$	1687 (raw)	68.2 %	1151 (raw)	-%	-	-%
$H \to \tau\tau$	1953 (raw)	70.1 %	1370 (raw)	-%	-	-%
$H \to \mu\mu$	9 (raw)	55.6 %	5 (raw)	-%	-	-%
$H \to \gamma\gamma$	74 (raw)	71.6 %	53 (raw)	-%	-	-%
$H \to \gamma Z$	48 (raw)	72.9 %	35 (raw)	-%	-	-%
$H \to WW^*$	5624 (raw)	69.3 %	3897 (raw)	-%	-	-%
$H \to WW^* \to qqqq$	2595 (raw)	68.3 %	1772 (raw)	-%	-	-%
$H \to WW^* \to qqll$	2410 (raw)	69.9 %	1685 (raw)	-%	-	-%
$H \to WW^* \to llll$	619 (raw)	71.1 %	440 (raw)	-%	-	-%
$H \to ZZ^*$	680 (raw)	70.7 %	481 (raw)	-%	-	-%
$H \to ZZ^* \to qqqq$	328 (raw)	73.2 %	240 (raw)	-%	-	-%
$H \to ZZ^* \to qqll$	297 (raw)	68.4 %	203 (raw)	-%	-	-%
$H \to ZZ^* \to llll$	55 (raw)	69.1 %	38 (raw)	-%	-	-%
$H \to$ invisible	-	-%	-	-%	-	-%
$Z \to ll$	3.2×10^6 (norm)	<0.1%	3921 (norm)	-%	-	-
$ZZ \to llll$	2.4×10^4 (norm)	1.29%	329 (norm)	-%	-	-
$ZZ \to qqll$	2.1×10^5 (norm)	0.57%	1334 (norm)	-%	-	-
$WW \to llll$	2.3×10^5 (norm)	0.39%	871 (norm)	-%	-	-
$WW \to qqll$	2.7×10^6 (norm)	<0.1%	255 (norm)	-%	-	-
$Zee \to llee$	1.7×10^5 (norm)	<0.1%	153 (norm)	-%	-	-

- Count the number of events. $\to \Delta\sigma_{HZ}/\sigma_{HZ} = \sqrt{S_{vis} + N_{(vis)}}/S_{vis} = \pm 5.1\%$ ($\mu\mu$ channnel).
- Toy MC. $\to \Delta\sigma_{HZ}/\sigma_{HZ} = \pm 3.0\%$ ($\mu\mu$ channnel).





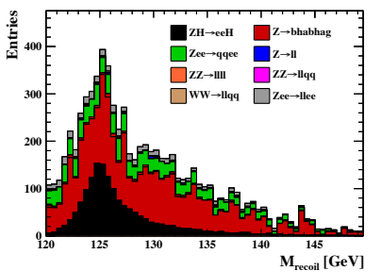


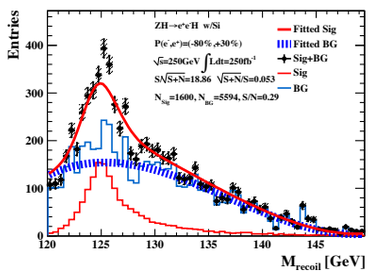
5.1 Si eeH 250GeV

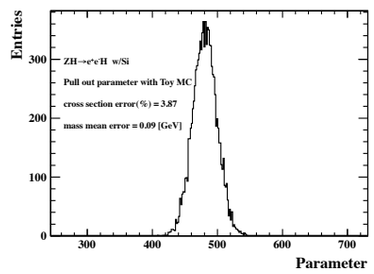
- $\sqrt{s}$=250GeV, L=250fb^{-1}, P(e^-, e^+) = P$(-0.8, +0.3)$.
- Signal is full reconstructed with SiECAL.
- Sig data (raw data) is 25K events. - BG data (raw data) is DST sample.

Process	$\sigma \cdot L$	$\epsilon^{vis}_{all-sel}$	$N^{vis}_{all-sel}$	$\epsilon^{inv}_{all-sel}$	$N^{inv}_{all-sel}$	$\epsilon^{vis+inv}$
ZH	2747 (norm)	58.2%	1600 (norm)	-%	-	-
$H \to b\bar{b}$	14177 (raw)	58.2 %	8253 (raw)	-%	-	-%
$H \to c\bar{c}$	672 (raw)	56.8 %	382 (raw)	-%	-	-%
$H \to s\bar{s}$	12 (raw)	83.4 %	10 (raw)	-%	-	-%
$H \to gluglu$	1671 (raw)	58.6 %	980 (raw)	-%	-	-%
$H \to \tau\tau$	1916 (raw)	59.0 %	1131 (raw)	-%	-	-%
$H \to \mu\mu$	2 (raw)	0 %	0 (raw)	-%	-	-%
$H \to \gamma\gamma$	80 (raw)	48.8 %	39 (raw)	-%	-	-%
$H \to \gamma Z$	43 (raw)	58.1 %	25 (raw)	-%	-	-%
$H \to WW^*$	5764 (raw)	57.8 %	3333 (raw)	-%	-	-%
$H \to WW^* \to qqqq$	2636 (raw)	58.2 %	1533 (raw)	-%	-	-%
$H \to WW^* \to qqll$	2502 (raw)	57.9 %	1450 (raw)	-%	-	-%
$H \to WW^* \to llll$	626 (raw)	55.9 %	350 (raw)	-%	-	-%
$H \to ZZ^*$	663 (raw)	61.4 %	406 (raw)	-%	-	-%
$H \to ZZ^* \to qqqq$	317 (raw)	63.7 %	202 (raw)	-%	-	-%
$H \to ZZ^* \to qqll$	274 (raw)	57.7 %	158 (raw)	-%	-	-%
$H \to ZZ^* \to llll$	72 (raw)	63.8 %	46 (raw)	-%	-	-%
$H \to$ invisible	-	-%	-	-%	-	-%
$ee \to ee(\gamma)$	3.9×10^6 (norm)	1.52%	1251 (norm)	-%	-	-
$Z \to ll$	3.2×10^6 (norm)	<0.1%	49 (norm)	-%	-	-
$ZZ \to llll$	2.4×10^4 (norm)	<0.1%	2 (norm)	-%	-	-
$ZZ \to qqll$	2.1×10^5 (norm)	<0.1%	4 (norm)	-%	-	-
$WW \to llll$	2.3×10^5 (norm)	<0.1%	0 (norm)	-%	-	-
$WW \to qqll$	2.7×10^6 (norm)	<0.1%	30 (norm)	-%	-	-
$Zee \to qqee$	6.9×10^4 (norm)	1.5%	1251 (norm)	-%	-	-
$Zee \to llee$	1.7×10^5 (norm)	0.21%	430 (norm)	-%	-	-

- Count the number of events. $\to \Delta\sigma_{HZ}/\sigma_{HZ} = \sqrt{S_{vis} + N_{(vis)}}/S_{vis} = \pm 5.3\%$ ($\mu\mu$ channnel).
- Toy MC. $\to \Delta\sigma_{HZ}/\sigma_{HZ} = \pm 3.8\%$ ($\mu\mu$ channnel).







Back up Slides

Summary of Recoil Mass@ 350GeV, P(-0.8, +0.3)
MVA Base Selection with SiECAL

10.1 Si $\mu\mu$H 350GeV

- $\sqrt{s}$=350GeV, L=$350fb^{-1}$, P(e^-, e^+) = P$(-0.8, +0.3)$.
- Signal is full reconstructed with SiECAL.
- Sig data (raw data) is 25K events. - BG data (raw data) is DST sample.

Process	$\sigma \cdot L$	$\epsilon^{vis}_{all-sel}$	$N^{vis}_{all-sel}$	$\epsilon^{inv}_{all-sel}$	$N^{inv}_{all-sel}$	$\epsilon^{vis+inv}$
ZH	2388 (norm)	58.2%	1388 (norm)	-%	-	-
$H \to b\bar{b}$	14163 (raw)	58.1 %	8224 (raw)	-%	-	-%
$H \to c\bar{c}$	723 (raw)	59.4 %	430 (raw)	-%	-	-%
$H \to s\bar{s}$	8 (raw)	87.5 %	7 (raw)	-%	-	-%
$H \to gluglu$	1701 (raw)	58.3 %	991 (raw)	-%	-	-%
$H \to \tau\tau$	1879 (raw)	59.1 %	1110 (raw)	-%	-	-%
$H \to \mu\mu$	4 (raw)	75.0 %	3 (raw)	-%	-	-%
$H \to \gamma\gamma$	61 (raw)	52.5 %	32 (raw)	-%	-	-%
$H \to \gamma Z$	48 (raw)	52.1 %	25 (raw)	-%	-	-%
$H \to WW^*$	5704 (raw)	57.9 %	3304 (raw)	-%	-	-%
$H \to WW^* \to qqqq$	2650 (raw)	57.5 %	1525 (raw)	-%	-	-%
$H \to WW^* \to qqll$	2442 (raw)	58.4 %	1426 (raw)	-%	-	-%
$H \to WW^* \to llll$	612 (raw)	57.7 %	353 (raw)	-%	-	-%
$H \to ZZ^*$	708 (raw)	58.3 %	413 (raw)	-%	-	-%
$H \to ZZ^* \to qqqq$	320 (raw)	57.8 %	185 (raw)	-%	-	-%
$H \to ZZ^* \to qqll$	313 (raw)	60.1 %	188 (raw)	-%	-	-%
$H \to ZZ^* \to llll$	75 (raw)	53.3 %	40 (raw)	-%	-	-%
$H \to$ invisible	-	-%	-	-%	-	-%
$Z \to ll$	2.3×10^6 (norm)	<0.1%	1235 (norm)	-%	-	-
$ZZ \to llll$	2.0×10^4 (norm)	1.17%	275 (norm)	-%	-	-
$ZZ \to qqll$	2.0×10^5 (norm)	0.55%	1190 (norm)	-%	-	-
$WW \to llll$	2.4×10^5 (norm)	<0.1%	8 (norm)	-%	-	-
$WW \to qqll$	2.9×10^6 (norm)	<0.1%	3 (norm)	-%	-	-
$Zee \to llee$	2.6×10^5 (norm)	<0.1%	115 (norm)	-%	-	-
$t\bar{t} \to qqqqlv$	2.6×10^4 (norm)	<0.1%	11 (norm)	-%	-	-

- Count the number of events. $\to \Delta\sigma_{HZ}/\sigma_{HZ} = \sqrt{S_{vis} + N_{(vis)}}/S_{vis} = \pm 4.7\%$ ($\mu\mu$ channnel).
- Toy MC. $\to \Delta\sigma_{HZ}/\sigma_{HZ} = \pm 3.6\%$ ($\mu\mu$ channnel).

11.1 Si eeH 350GeV

- $\sqrt{s}$=350GeV, L=$350fb^{-1}$, P(e^-, e^+) = P$(-0.8, +0.3)$.
- Signal is full reconstructed with SiECAL.
- Sig data (raw data) is 25K events. - BG data (raw data) is DST sample.

Process	$\sigma \cdot L$	$\epsilon^{vis}_{all-sel}$	$N^{vis}_{all-sel}$	$\epsilon^{inv}_{all-sel}$	$N^{inv}_{all-sel}$	$\epsilon^{vis+inv}$
ZH	3579 (norm)	29.6%	1057 (norm)	-%	-	-
$H \to b\bar{b}$	14033 (raw)	35.6 %	4992 (raw)	-%	-	-%
$H \to c\bar{c}$	696 (raw)	36.9 %	257 (raw)	-%	-	-%
$H \to s\bar{s}$	8 (raw)	25.0 %	2 (raw)	-%	-	-%
$H \to gluglu$	1670 (raw)	37.7 %	629 (raw)	-%	-	-%
$H \to \tau\tau$	1919 (raw)	34.9 %	671 (raw)	-%	-	-%
$H \to \mu\mu$	4 (raw)	75.0 %	3 (raw)	-%	-	-%
$H \to \gamma\gamma$	92 (raw)	31.5 %	29 (raw)	-%	-	-%
$H \to \gamma Z$	44 (raw)	36.4 %	16 (raw)	-%	-	-%
$H \to WW^*$	5735 (raw)	36.4 %	2087 (raw)	-%	-	-%
$H \to WW^* \to qqqq$	2619 (raw)	36.4 %	952 (raw)	-%	-	-%
$H \to WW^* \to qqll$	2515 (raw)	36.5 %	919 (raw)	-%	-	-%
$H \to WW^* \to llll$	601 (raw)	35.9 %	216 (raw)	-%	-	-%
$H \to ZZ^*$	724 (raw)	35.1 %	254 (raw)	-%	-	-%
$H \to ZZ^* \to qqqq$	367 (raw)	37.6 %	138 (raw)	-%	-	-%
$H \to ZZ^* \to qqll$	303 (raw)	32.7 %	99 (raw)	-%	-	-%
$H \to ZZ^* \to llll$	54 (raw)	31.5 %	17 (raw)	-%	-	-%
$H \to$ invisible	-	-%	-	-%	-	-%
$ee \to ee(\gamma)$	6.0×10^6 (norm)	<0.1%	2907 (norm)	-%	-	-
$Z \to ll$	2.3×10^6 (norm)	<0.1%	10 (norm)	-%	-	-
$ZZ \to llll$	2.0×10^4 (norm)	<0.1%	1 (norm)	-%	-	-
$ZZ \to qqll$	2.0×10^5 (norm)	<0.1%	0 (norm)	-%	-	-
$WW \to llll$	2.4×10^5 (norm)	<0.1%	0 (norm)	-%	-	-
$WW \to qqll$	2.9×10^6 (norm)	<0.1%	0 (norm)	-%	-	-
$Zee \to qqee$	1.1×10^5 (norm)	1.4%	1855 (norm)	-%	-	-
$Zee \to llee$	2.6×10^5 (norm)	0.17%	599 (norm)	-%	-	-
$t\bar{t} \to qqqqlv$	2.6×10^4 (norm)	<0.1%	14 (norm)	-%	-	-

- Count the number of events. $\to \Delta\sigma_{HZ}/\sigma_{HZ} = \sqrt{S_{vis} + N_{(vis)}}/S_{vis} = \pm 6.4\%$ (ee channnel).
- Toy MC. $\to \Delta\sigma_{HZ}/\sigma_{HZ} = \pm 4.2\%$ (ee channnel).