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

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Today's report :

➡ Analysis of invisible higgs decay with two ECAL options.

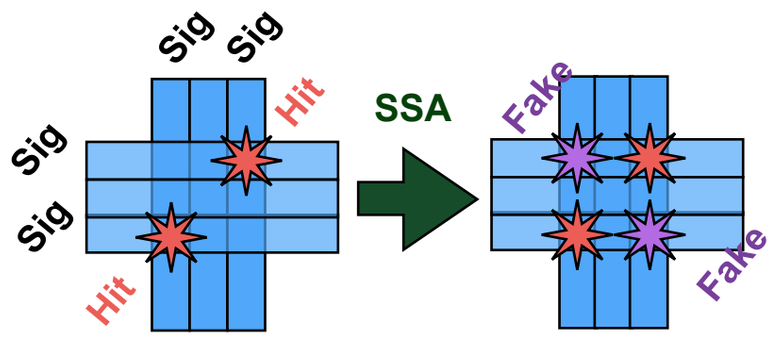
My Motivation

1. My motivation is to compare performance between SiECAL and ScECAL

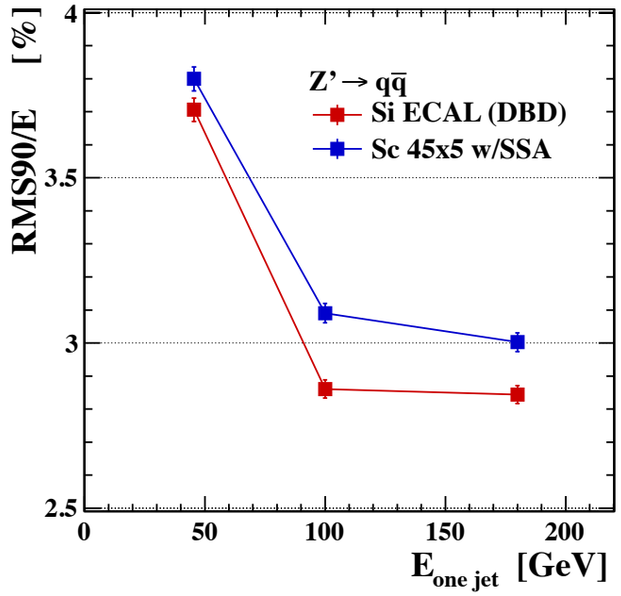
- JER b/w Si and Sc is slightly difference, ~ 0.3%.

- Sc has problem due to fake hits.

➡ Problem of fake hits



➡ Jet Energy Resolution



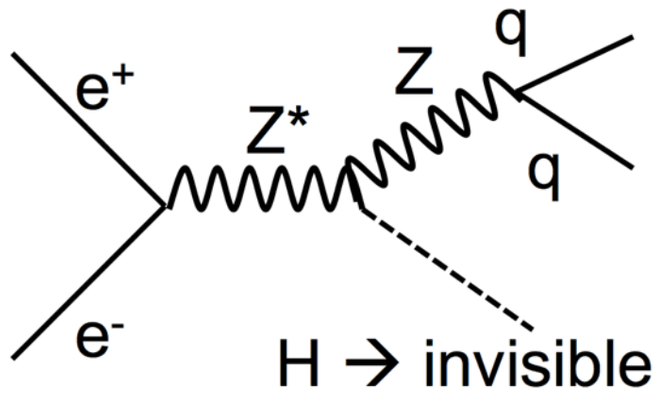
2. Invisible Higgs decays

- For detectors.

  - Jet Energy Resolution is essential.

- For physics.

  - It is clear signal for new physics.



My Simulation condition & Analysis flow

1. Simulation condition.

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

- All sample are full reconstructed by using SiECAL and ScECAL.

Sig) ZH ➡ qqH : H ➡ invisible decay (?). **(For now, H->ZZ->vvvv.)**

I assumed Br is 5%.

- I generated only most dominant BG by using two ECals.

BG) ZZ→qqll, WW→qqll, Zvv→qqvv.

2. Cross section.

Process	$\sigma(fb)$	$\sigma \cdot L$
$ZH \to qqH_{inv}$ (Br5%)	10.6	2650
$ZH \to qqH$ (SM)	212.2 - 10.6	53058 - 2650
$ZH \to vvH$ (SM)	78.3	19573
$ZZ \to qqll$	685.4	1.7×10^5
$WW \to qqll$	10955	2.7×10^6
$Zvv \to qqvv$	272.3	68082

Signal: Z mass

1. Comparison of Z mass.

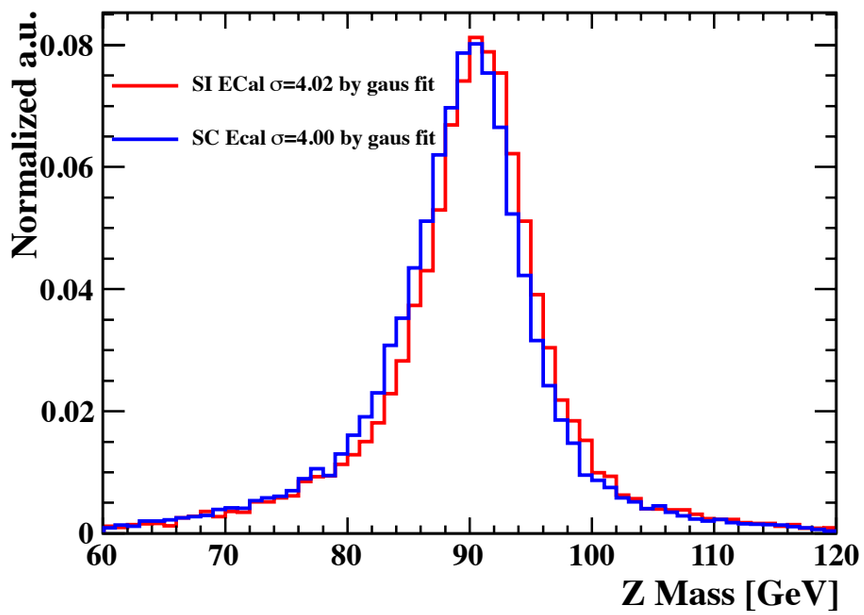
- Width and Resolution.

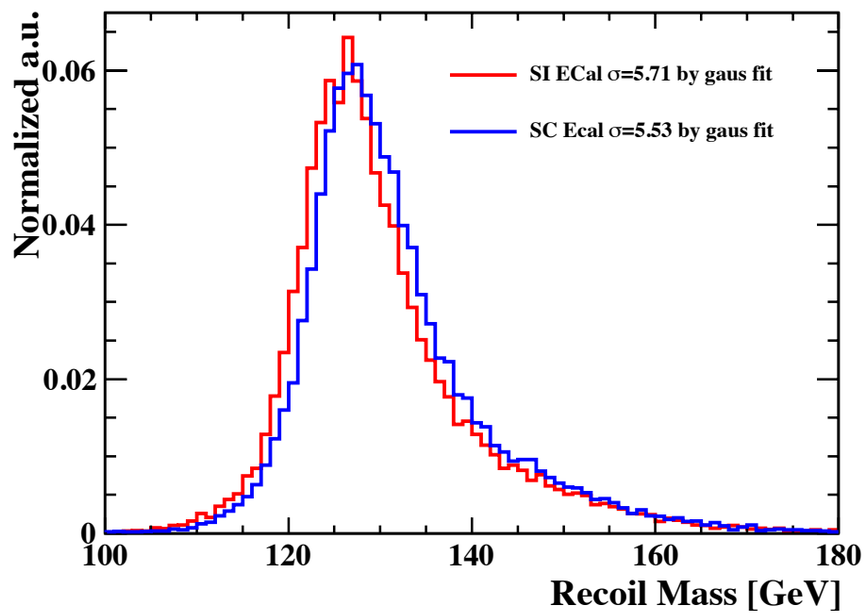
- SiECal: Sigma with Gaussian is 4.0GeV. (Mean with Gaussian 90.8GeV)
  Resolution is 4.4%.

- ScECal: Sigma with Gaussian is 4.0GeV. (Mean with Gaussian 90.1GeV)
  Resolution is 4.4%.

- Reason of shift from SI.

- Not enough tuning of SC ECal, Miss clustering, or …



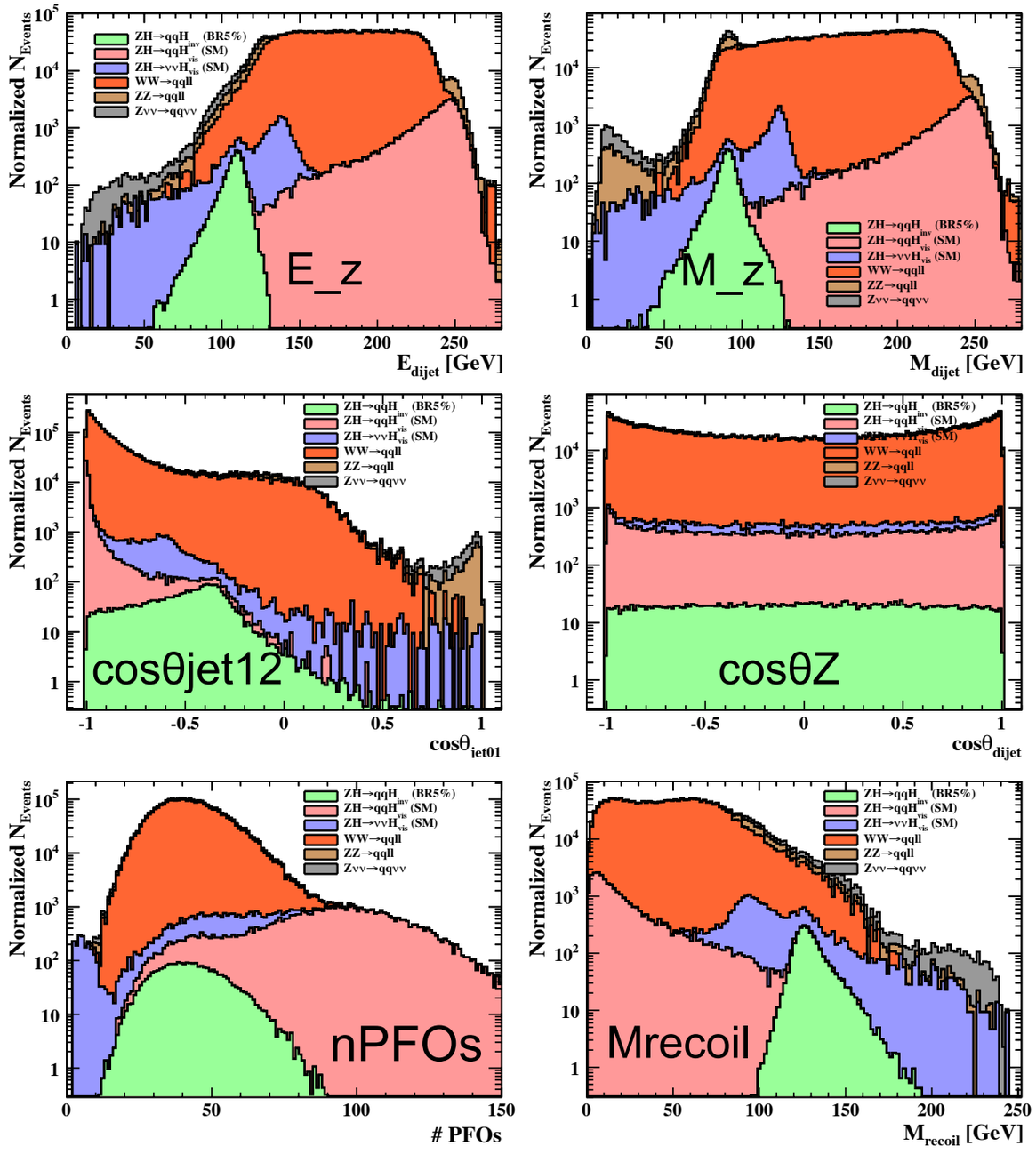


Background Suppression

1. Comparison of Z mass.

0) 20< logY23 <75
0) 20< nPFOs <75
1) visE < 130
2) |cosθjet2| <0.95
3) -0.8 < |cosθjet12| <0.1
4) |cosθZ| <0.95
5) Pt^2_jet1>7000
6) 70< E_z < 130
7) 75 < M_z <105
8) 108< Mrecoil < 160

➡ Some distributions with SI ECal.



1. Signal ε.

- Same cut values were applied for both ECals.

SIECal: ε = 61.0%

SCECal: ε = 61.8%

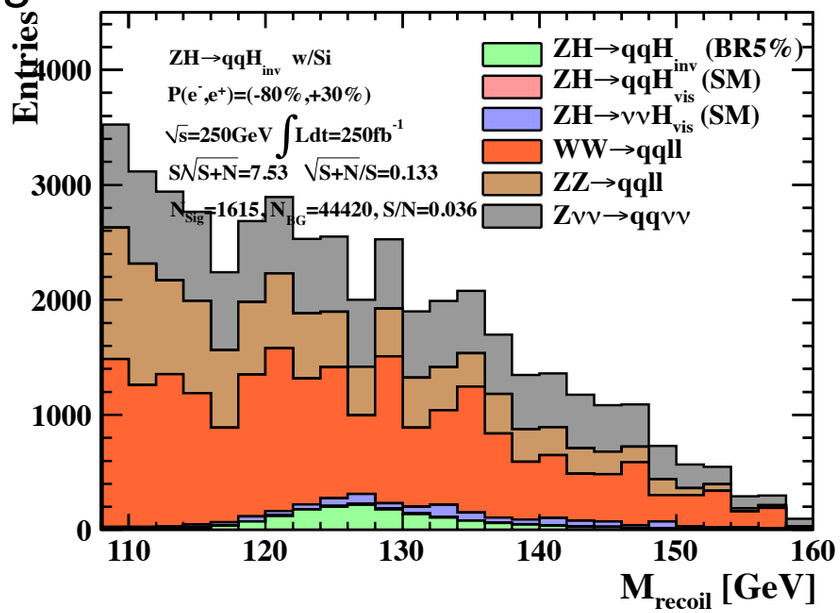
Signal Overlaid with BG

1.1 $ZH \to qqH_{inv}$ at 250GeV with SI and SC ECal

1. SI ECal:

N_sig = 1615, N_BG = 44420, S/N = 3.6%, Significance = 7.53

Process	$\epsilon_{all-sel}(\%)$	$N_{all-sel}$ (Norm)
$ZH \to qqH_{inv}$ (Br5%)	61.0	1615
$ZH \to qqH$ (SM)	0.13	68
$ZH \to vvH$ (SM)	5.34	1045
$ZZ \to qqll$	6.12	10493
$WW \to qqll$	0.72	19742
$Zvv \to qqvv$	19.2	13073

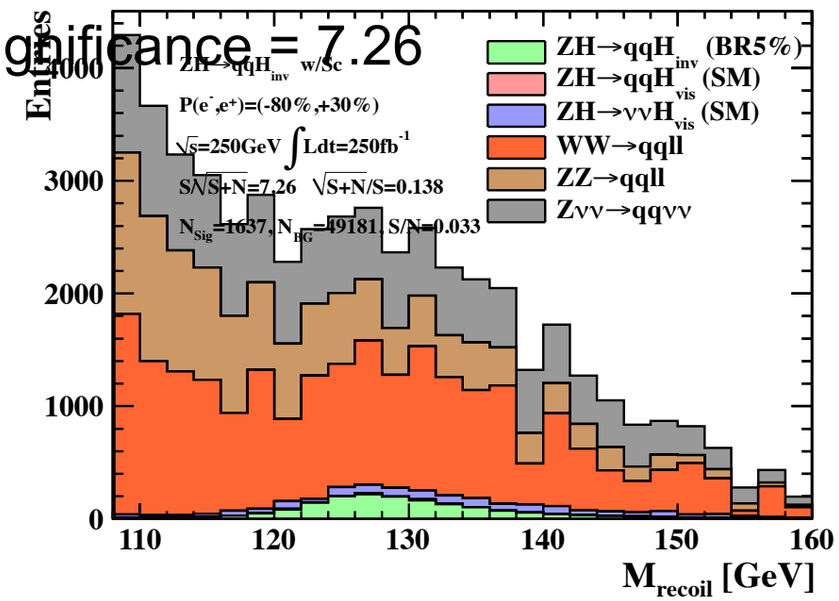


2. SC ECal:

N_sig = 1637, N_BG = 49181, S/N = 3.3%, Significance = 7.26

much more ~10% than SI

Process	$\epsilon_{all-sel}(\%)$	$N_{all-sel}$ (Norm)
$ZH \to qqH_{inv}$ (Br5%)	61.8	1637
$ZH \to qqH$ (SM)	0.09	49
$ZH \to vvH$ (SM)	6.31	1234
$ZZ \to qqll$	7.23	12395
$WW \to qqll$	0.77	21179
$Zvv \to qqvv$	21.0	14323



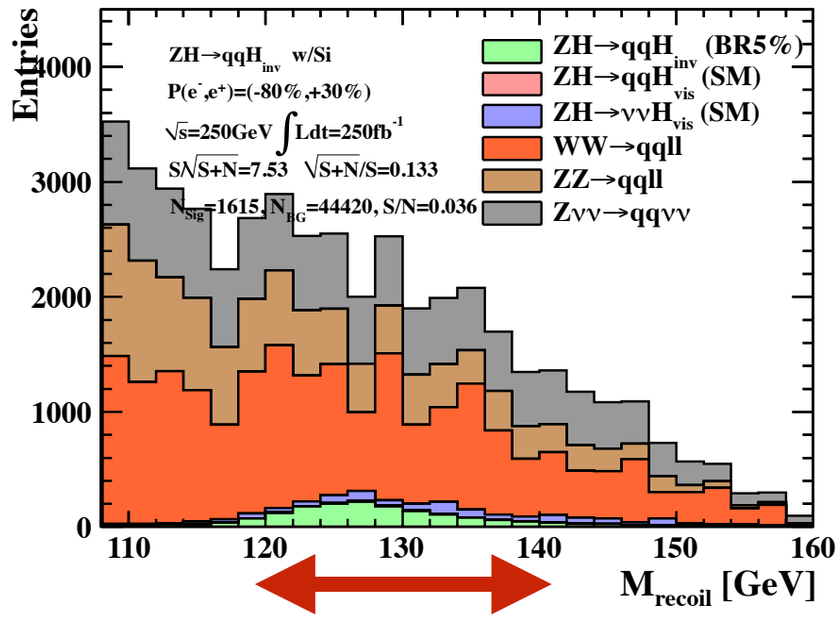
Signal Overlaid with BG

1.1 $ZH \to qqH_{inv}$ at 250GeV with SI and SC ECal

1. SI ECal:

More tight recoil window

N_sig = 1320, N_BG = 20198, S/N = 6.5%,

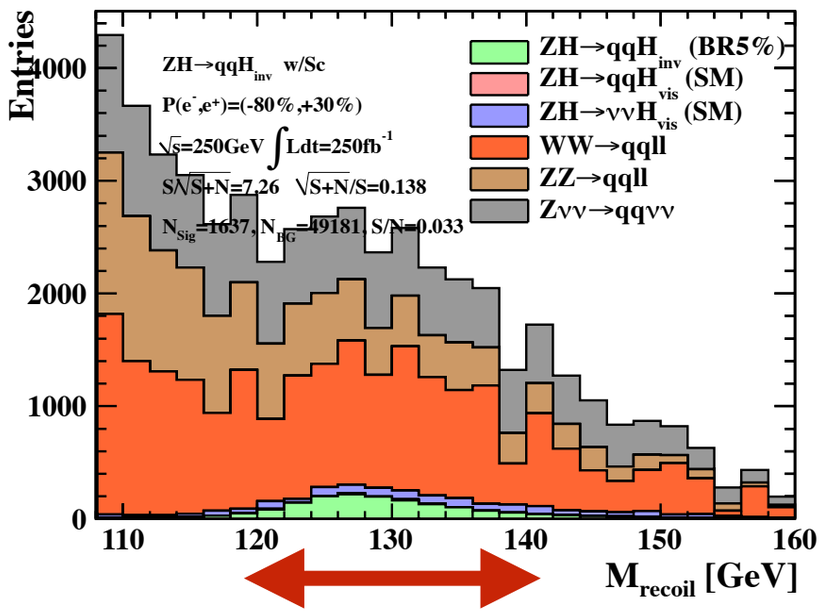


2. SC ECal:

N_sig = 1366, N_BG = 21603, S/N = 6.3%.

much more ~5% than SI

Still slightly not good



Today's summary & Next step

- I analyzed invisible Higgs decay with two ECAL options.

- As a result in 250GeV case,
  performance of SC ECAL just slightly became worse?

- Estimation of upper limits on the BF with Toy MC.

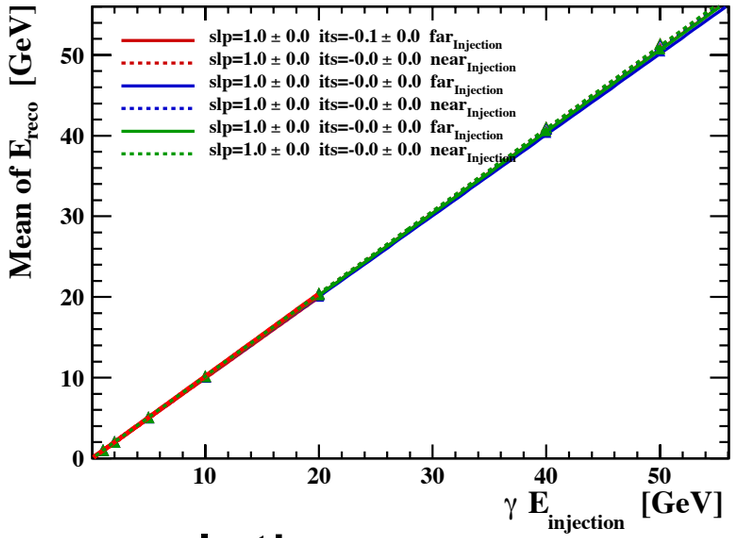
- Try with MVA selection.

- Then move on 350GeV case.

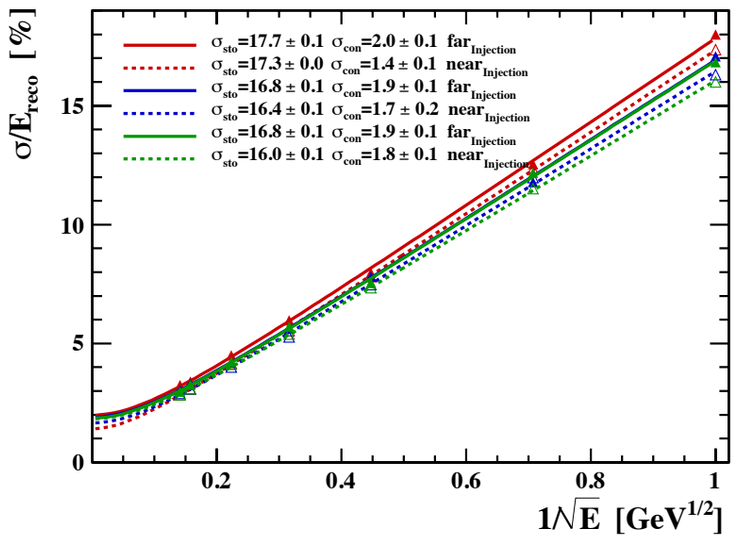
Back up Slides

Tuning of SiECAL and ScECAL

➡ Linearity



➡ Energy resolution



➡ JER