Branching ratio study in ZH→qqcc/bb

ILC physics and software meeting

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Current status

- ## Previous meeting
  - Check consistency with SiD group result
    - Some distribution has large discrepancy
      (# of charged tracks, Highest photon energy)

- ## This meeting
  - We received the replay from SiD people
  - Reason of difference has clarified.
    - Most of them are typing miss
  - Add nnH, llH samples to make a generated event consistency with SiD analysis
  - Add ll samples into BG

Cut parameters correction with SiD

Classification (Evis > 170 GeV + No leptons)

1. # of charged track <u>in each jet</u> > 4 (not in event!)

2. $-\log10(Y34) < 2.7$ ($3 \rightarrow 4$ Jet combination threshold)

3. thrust < 0.95

4. $|\cos\theta_{thrusut}| < 0.96$

5. $105 < \underline{\theta_{Hjets}} < 165$ (not J_1J_3 angle)

6. $70 < \theta_{Zjets} < 160$ (not J_2J_4 angle)

7. $110 < M_{Hfit} < 140$ GeV

8. $80 < M_{Zfit} < 110$ GeV

9. $E\gamma < 10$ GeV <u>in each jet</u> (not in event!)

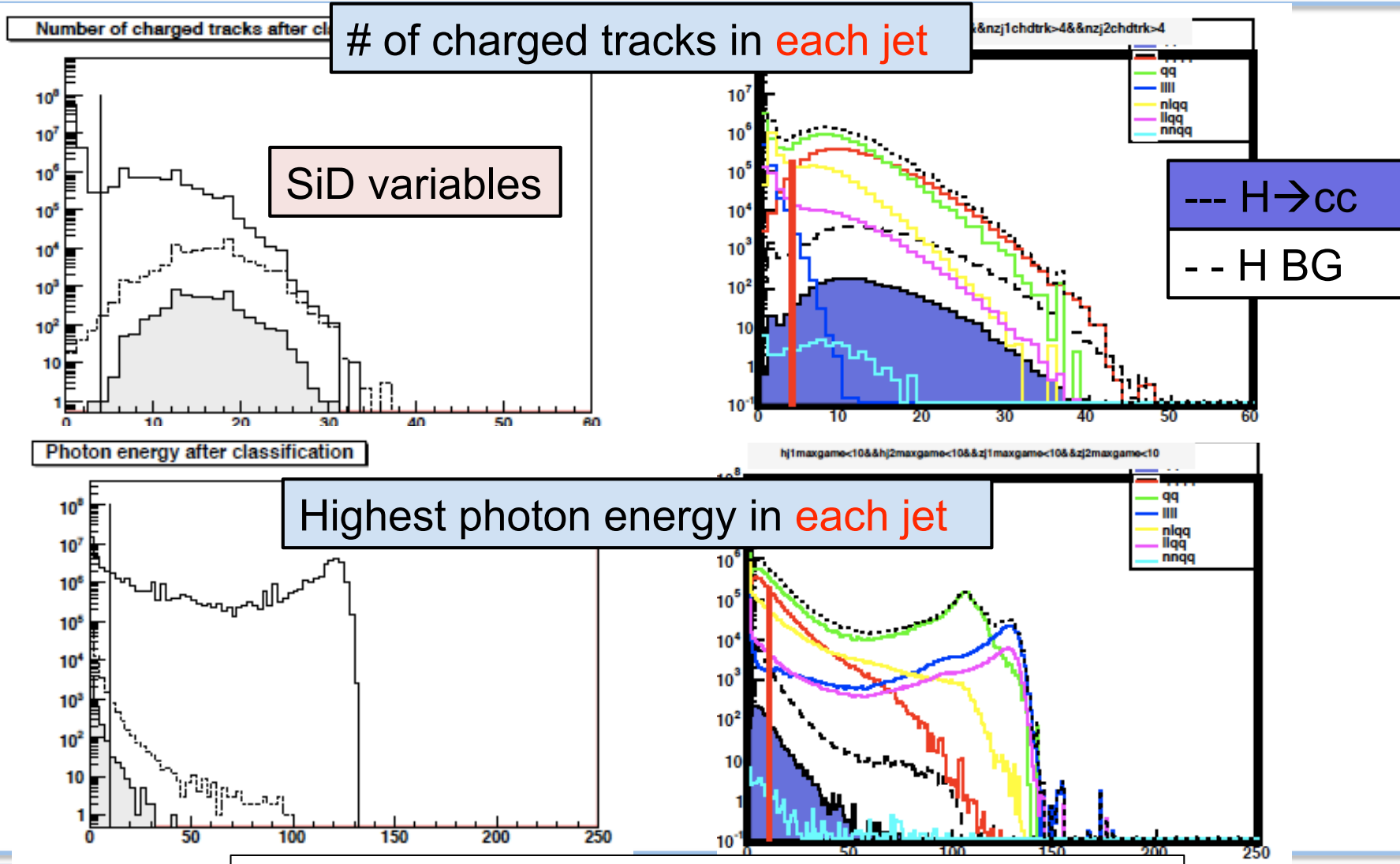| |
|---|
| (0) Evis>170 GeV |
| (1) charged track>4 |
| (2) $-\log10(Y34) < 2.7$ |
| (3) thrust < 0.95 |
| (4) $|\cos\theta_{thrust}| < 0.96$ |
| (5) $105 < \theta_{j1j3} < 165$ |
| (6) $70 < \theta_{j2j4} < 160$ |
| (7) $110 < M_{Hfit} < 140$ GeV |
| (8) $80 < M_{Zfit} < 110$ GeV |
| (9) $E\gamma < 10$ GeV |

Variables consistency (each jet)

Number of charged tracks after cl...

# of charged tracks in each jet

SiD variables

--- H→cc
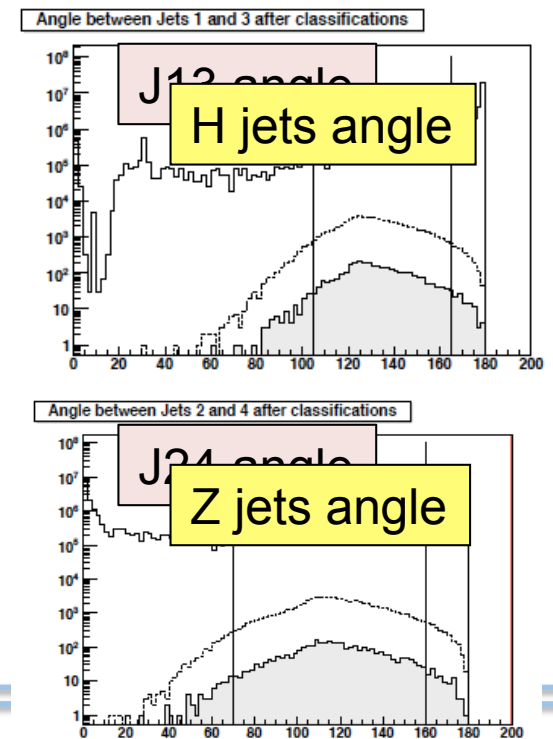
- - H BG

Photon energy after classification

Highest photon energy in each jet
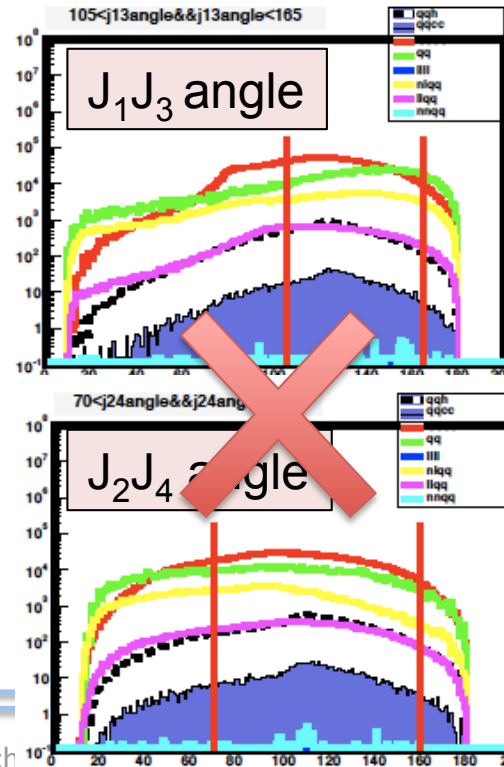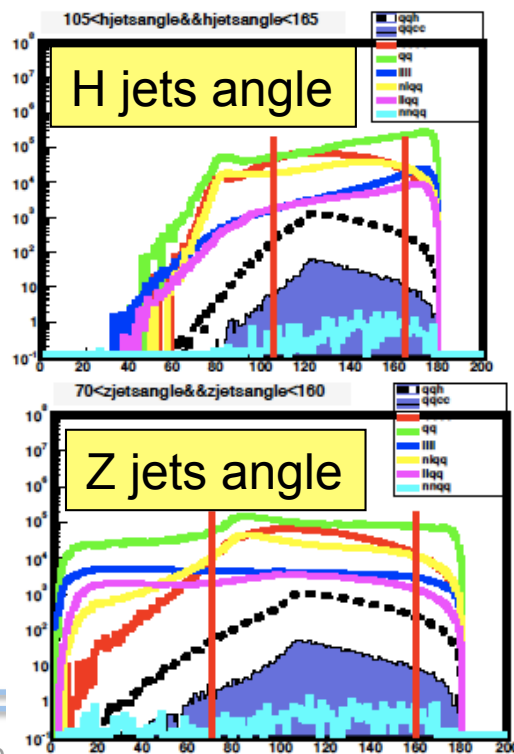
Still there are some discrepancy in signal distribution

Jets angle definition

- I also found some difference between SiD cut value
  - H jets angle (my) – J_1J_3 jets angle (SiD)
  - Z jets angle (my) – J_2J_4 jets angle (SiD)

  (Suffixes means the order of the jet energy)

Reduction summary comparison (Previous)

Large Higgs BG difference

	qqcc	qqcc(ono)	qqH BG	qqH BG (ono)	SM Bkg	SM Bkg (ono)
No cuts	2869		76910		9275594683	
After classification (evis>170)	1837	1915.57	41016	48056.6	39398366	44827158
(1) charged track>4	1143	1880.38	19954	43827.6	18601753	7822129
(2) -log10(Y34) < 2.7	1101	1842.5	19011	43119.5	13921271	5120319
(3) thrust < 0.95	1047	1840.85	17743	43092	8737017	4991231
(4) $|\cos\theta_{thrust}| < 0.96$	1017	1753.94	17106	41066.6	7943851	4368148
(5) $105 < \theta_{j1j3} < 165$	979	1639.8	16262	38059.2	5871237	3596979
(6) $70 < \theta_{j2j4} < 160$	978	1558.28	16247	36207.1	4898312	3335553
(7) $110 < M_{Hfit} < 140$ GeV	966	1489.19	16027	34389.3	1917231	2169390
(8) $80 < M_{Zfit} < 110$ GeV	963	1489.19	16018	34380.7	1561432	2164332
(9) $E\gamma < 10$ GeV	947	767.217	15687	19260.3	967312	956570

Consistent selections with SiD

	qqcc	qqcc(ono)	qqH BG	qqH BG (ono)	SM Bkg	SM Bkg (ono)
No cuts	2869	2914	76910	76927	9275594683	4376090000
After classification (Evis>170&&nLeptons=0)	1837	1693	41016	38273	39398366	2410080000
(1) charged track>4 (jet)	1143	1238	19954	27925	18601753	3323060
(2) -log10(Y34) < 2.7	1101	1218	19011	27563	13921271	2635920
(3) thrust < 0.95	1047	1217	17743	27551	8737017	2584510
(4) $|\cos\theta_{thrust}|$ < 0.96	1017	1157	17106	26258	7943851	2295690
(5) 105 < θ_{Hj} < 165 (hjet)	979	1080	16262	24334	5871237	1908300
(6) 70 < θ_{Zj} < 160 (Zjet)	978	1028	16247	23195	4898312	1776150
(7) 110 < M_{Hfit}< 140 GeV	966	904	16027	19974	1917231	920962
(8) 80 < M_{Zfit}< 110 GeV	963	904	16018	19973	1561432	919540
(9) Eγ<10 GeV (jets)	947	622	15687	14613	967312	575081

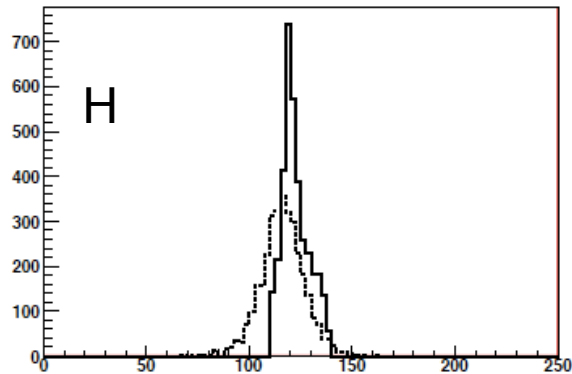Still some difference in Highest photon cut

Summary

- Signal
  - Highest photon cut has still some difference, checking code and their note, tune cut position.

- Higgs BG
  - Better consistency compare to previous selection

- Shift to template fitting again after clarify difference.
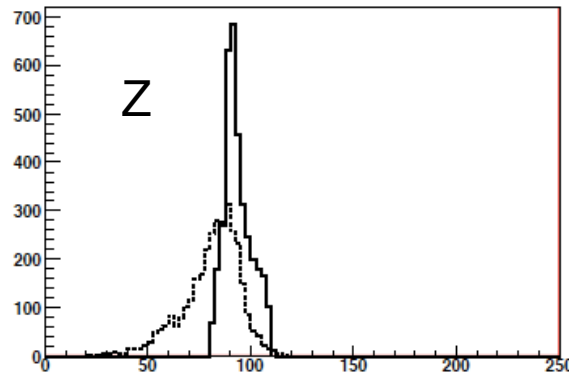
H/Z fitted mass distribution

SiD : solid line shows the fitted H/Z mass

(a)

(b)

$$\sum_{i=0}^{2} P_i = 0$$
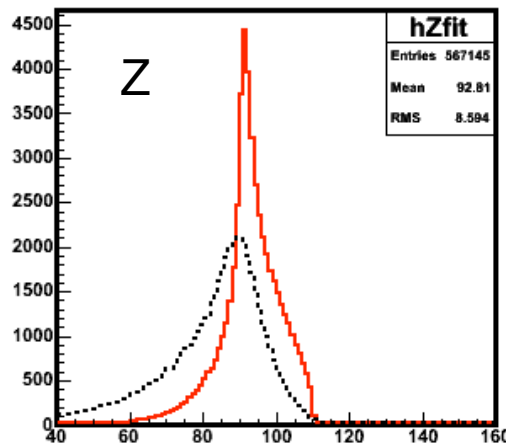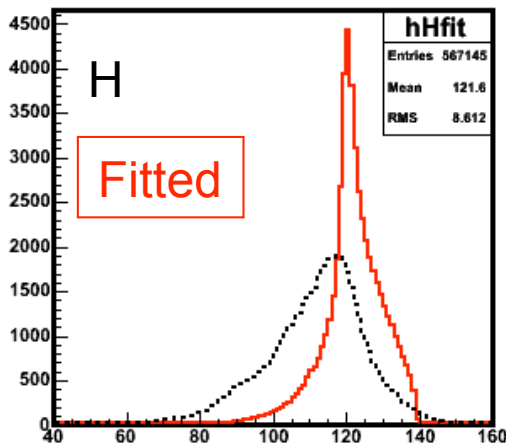
ΣE=250 GeV
$M_{ij}-M_{kl}=M_H-M_Z$
constraint in SiD

Fitted

In my H/Z fitted mass distribution, there are lower tail.

Other/Different constraints are applied in SiD?

My case
Sp=0, SE=250, M_H-M_Z constraint