ZH Branching ratio study

ILC physics and software meeting
Oct. 15. 2010

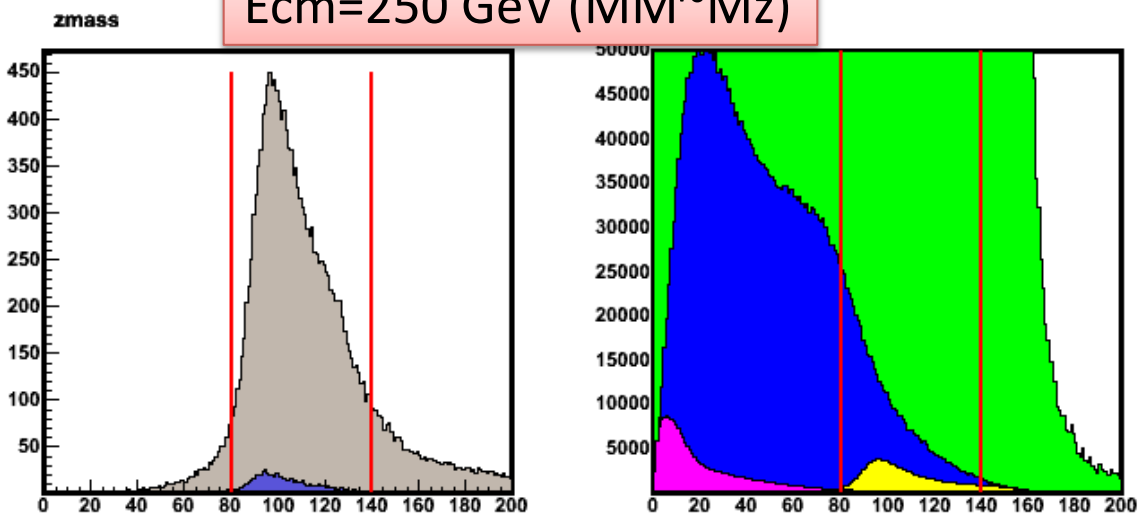
H. Ono (NDU)

Current status

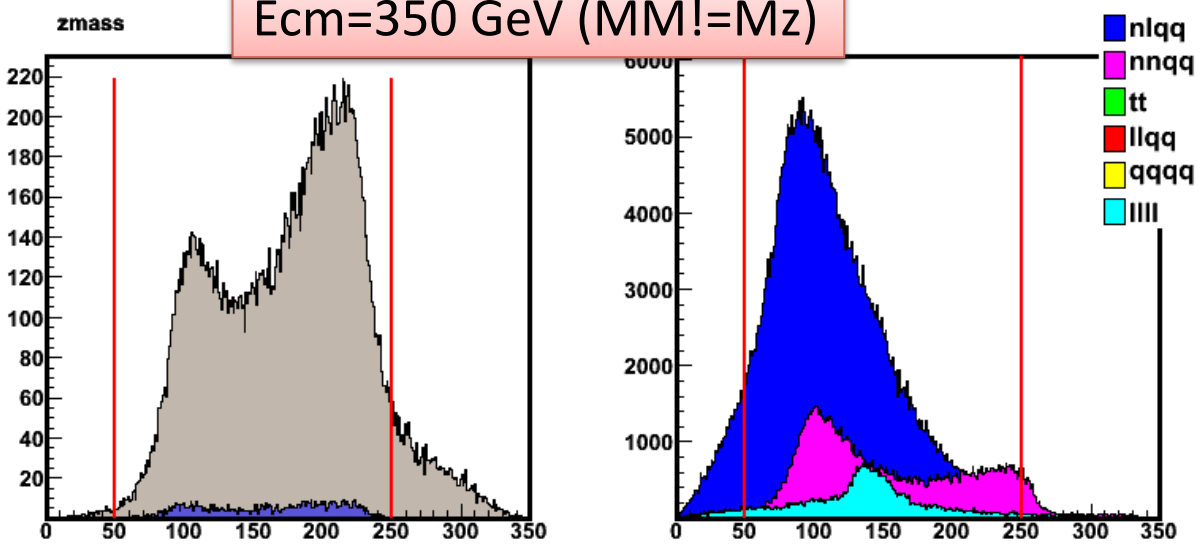
- vvH study start
  - Increase t-channel contamination at 350 GeV (107fb/131fb)
  - Optimizing selection criteria for 350 GeV sample
- Check the reason of better S/N in 350 GeV for qqH
  - Several distribution are checked
  - qq event generation is on going
  - Try to remove qq background from 250 GeV sample and compare the relative BR measurement accuracy
- No significant update is included for ECFA meeting after the last meeting

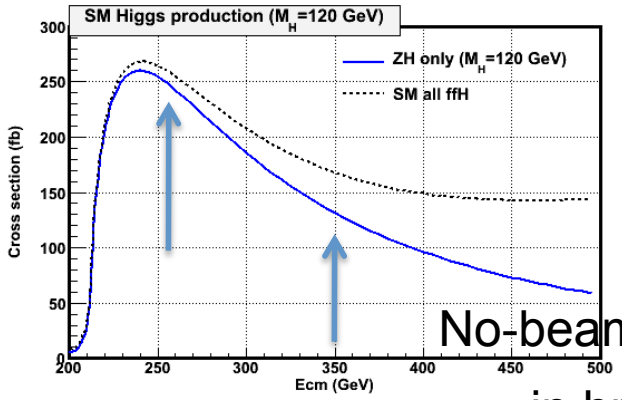
vvH study (MissingMass)

Ecm=250 GeV (MM~Mz)



Ecm=350 GeV (MM!=Mz)



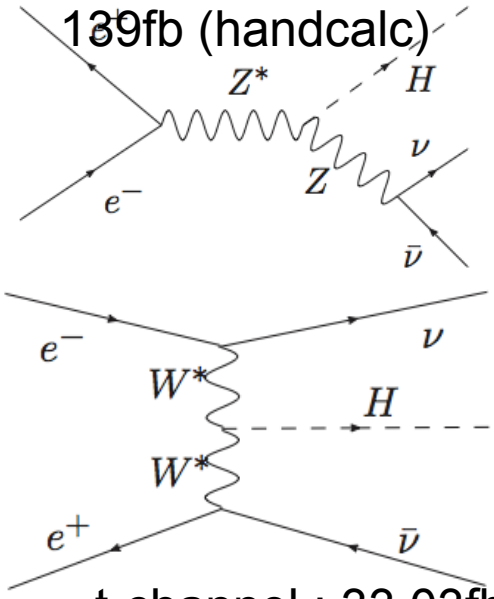


No-beampol

in hprod

s-channel : 131.4fb

139fb (handcalc)

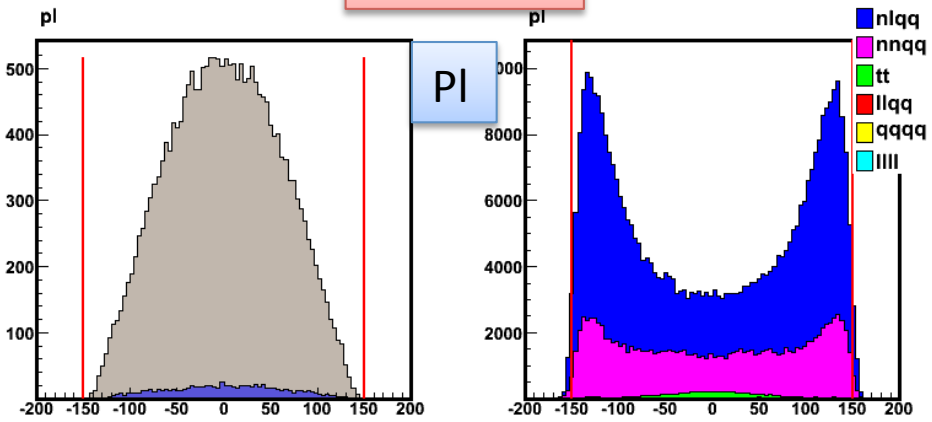


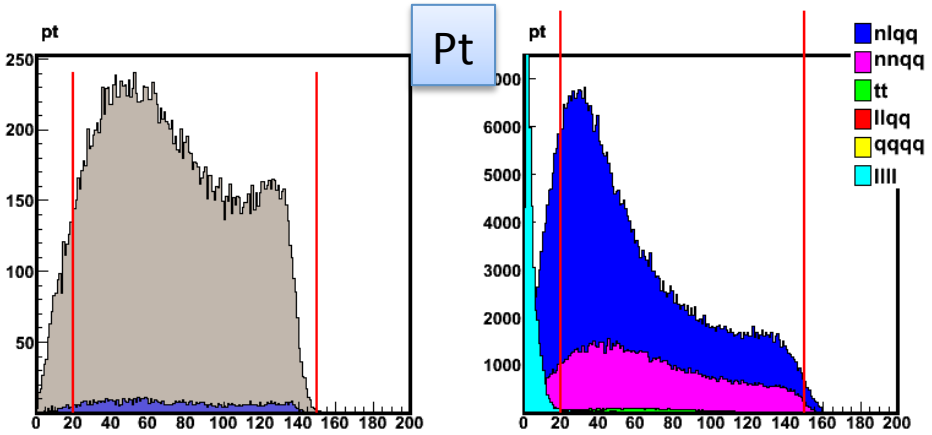
t-channel : 33.03fb

26.8fb (handcalc)

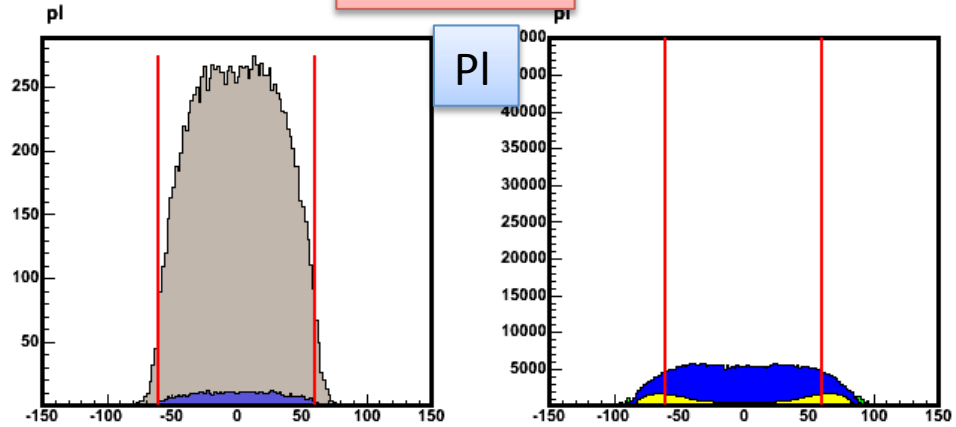
vvH

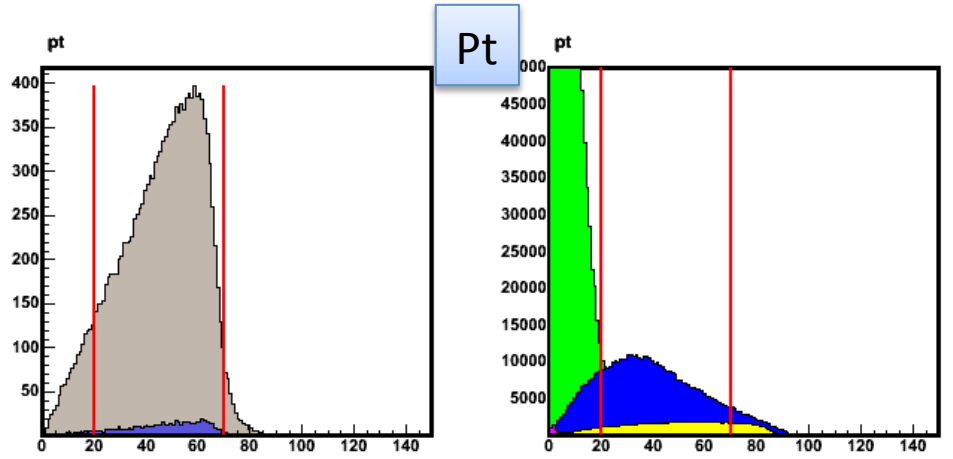
350 GeV





250 GeV





Background reduction summary (ZH→qqH)

250 GeV	No cuts	chi2	Ntrack	-Log(Y34)	thrust	cosθ	θH	Mh	Eff
H→cc	1916	1460	1114	1102	1081	963	890	804	41.9%
H→bb	34963	24568	19542	19351	19013	16854	15488	13651	39.0%
ZH→qqH all	52507	32430	25252	25037	24656	21856	20041	17617	33.6%
SM Bkg	44825201	2608604	1120793	1002011	935788	696026	621975	504788	1.1%
BG w/o qq	9472101	1388294	824641	818608	815228	591524	533500	430998	4.6%
$S_{cc}/\sqrt{B}$	0.05	0.31	1.05	1.10	1.12	1.15	1.13	1.13	
$S_{bb}/\sqrt{B}$	0.86	5.27	18.46	19.33	19.65	20.20	19.64	19.21	

350 GeV	No cuts	chi2	Ntrack	-Log(Y34)	thrust	cosθ	θH	Mh	Eff
H→cc	1296	899	672	652	599	562	525	465	35.9%
H→bb	24051	14919	11589	11275	10410	9675	8879	7665	31.9%
ZH→qqH all	36099	20203	14905	14546	13524	12572	11278	9723	26.9%
SM Bkg	8266030	509774	209765	197726	114841	85787	60331	32896	0.4%
$S_{cc}/\sqrt{B}$	0.45	1.26	1.47	1.47	1.77	1.92	2.14	2.56	
$S_{bb}/\sqrt{B}$	8.37	20.90	25.30	25.36	30.72	33.03	36.15	42.26	

Relative BR comparison

Relative branching fraction has checked for Ecm=250, 350 GeV

$$\frac{Br(H \to c\bar{c})}{Br(H \to b\bar{b})} = \frac{r_{cc}/\varepsilon_{cc}}{r_{bb}/\varepsilon_{bb}}$$

ZH→vvH neutrino mode analysis is now in progress

Efficiency	Ecm=250 GeV		Ecm=350 GeV
	neutrino	hadron	hadron
ε_{bb}	36.8%	39.0%	31.7%
ε_{cc}	41.8%	41.9%	35.4%

Fitted results	Ecm=250 GeV			Ecm=350 GeV
mode	neutrino	hadron	w/o qq	hadron
rbb	0.853+−0.009	0.774+−0.013	0.775+-0.014	0.788+−0.008
rcc	0.052+−0.004	0.046+−0.005	0.046+-0.004	0.048+−0.002
BR(cc)/BR(bb)	0.054+−0.004	0.055+−0.006	0.055+-0.005	0.054+−0.003
ΔBR(cc)/BR(bb)	7.94%	10.15%	9.68%	6.18%

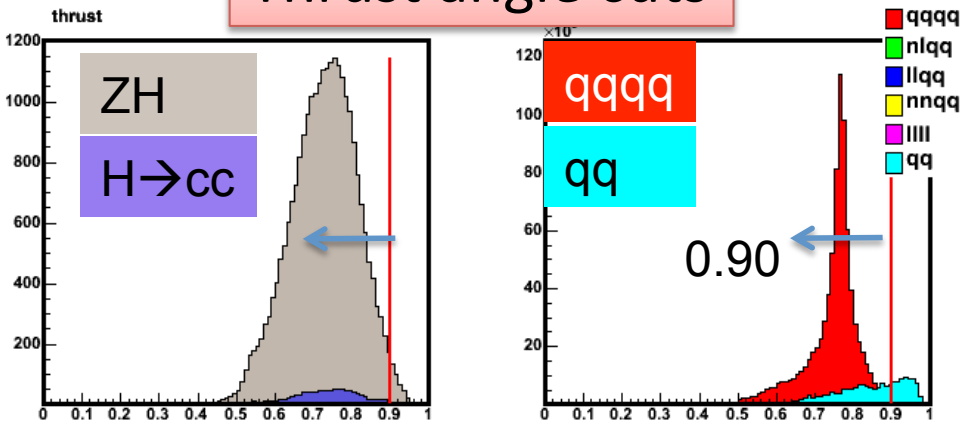
statistic only

Preliminary

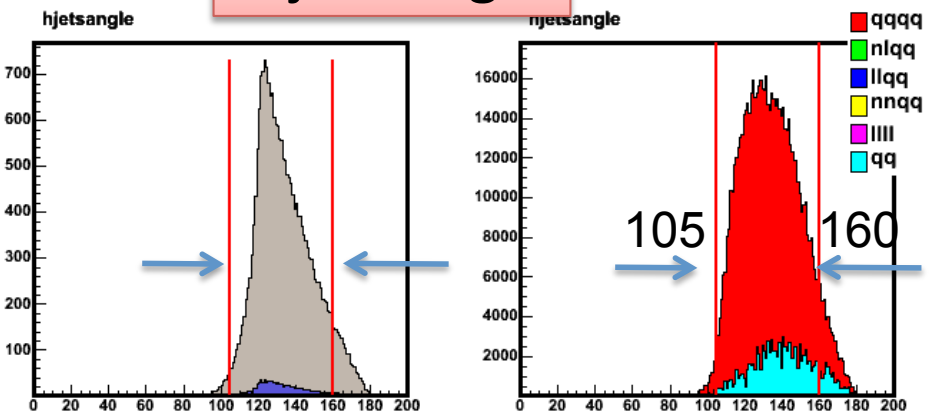
Measurement accuracy looks improved in hadron mode, caused by better S/√N?

ZH→qqH cut optimization at 250 GeV

Thrust angle cuts

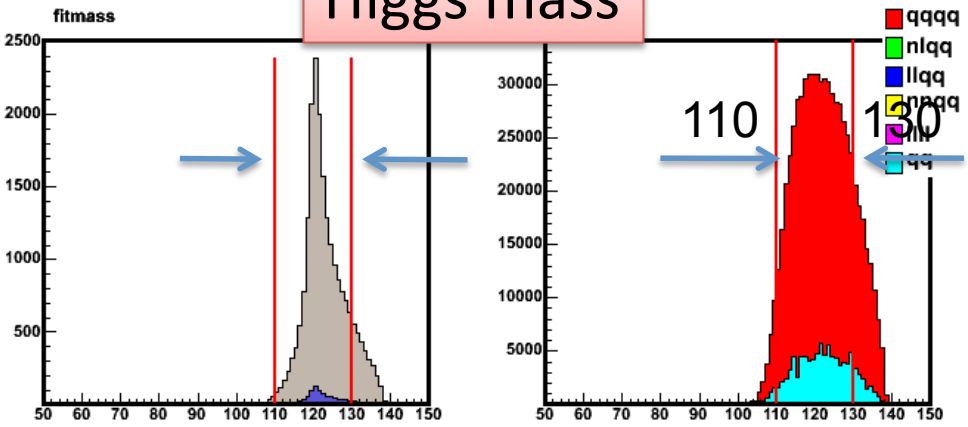


H jets angle



degree

Higgs mass

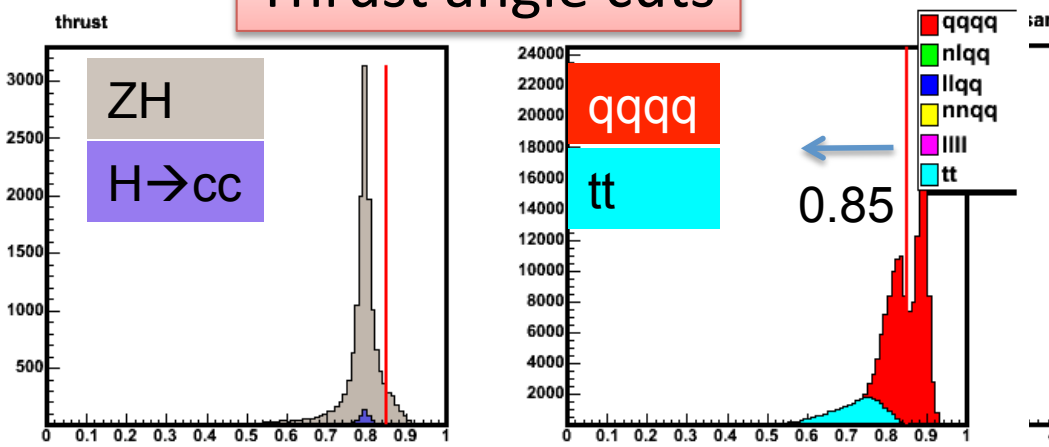


M_H(GeV)

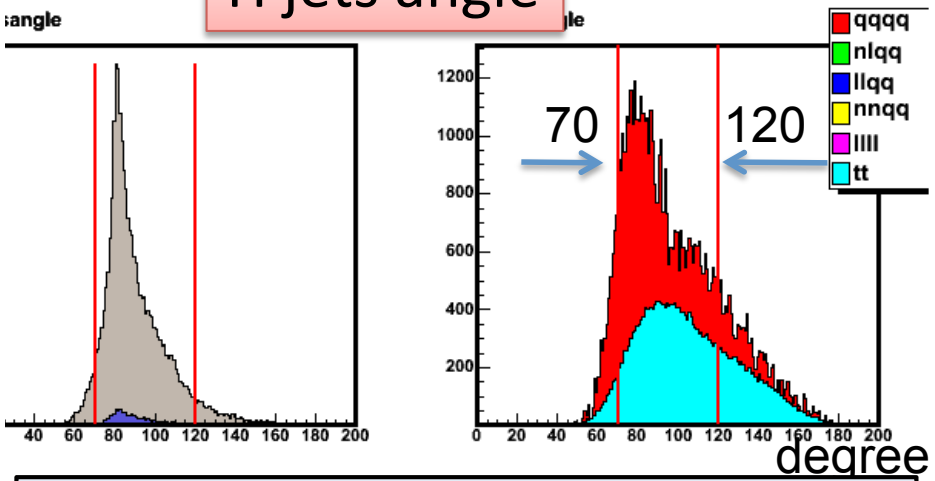
250 GeV final state will be spherical compare to 350 GeV especially for hadronic mode

ZH→qqH cut optimization at 350 GeV

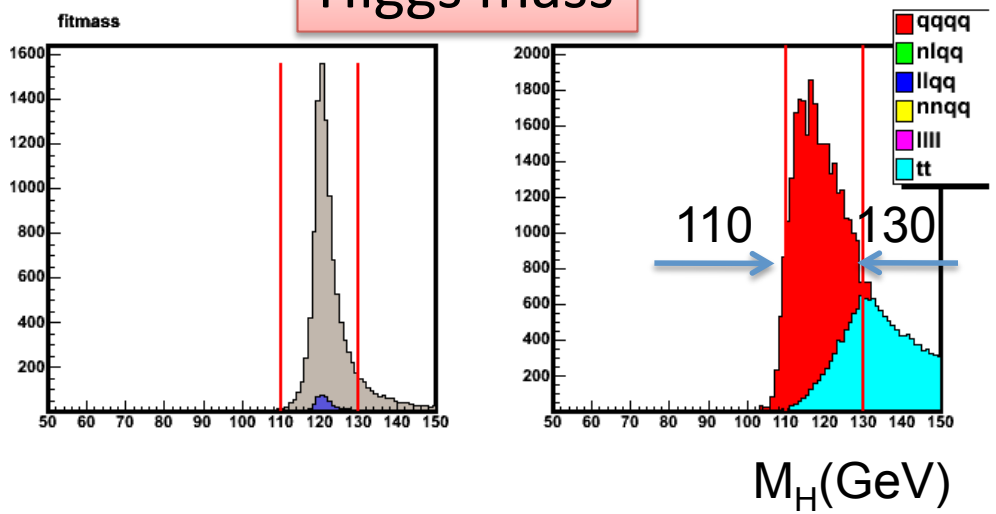
Thrust angle cuts



H jets angle



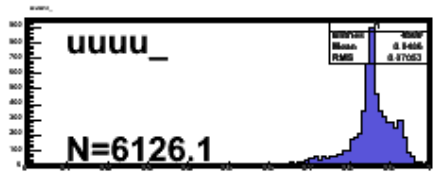
Higgs mass

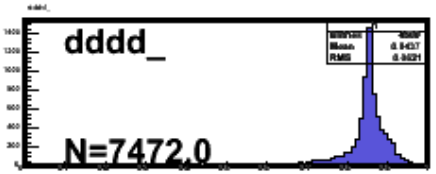


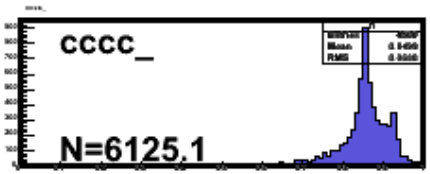
From the different event shape, cut positions are optimized for 350 GeV.

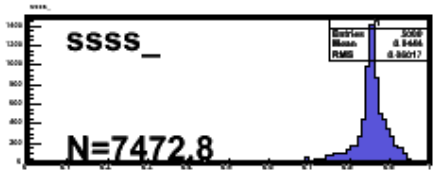
S/√N looks improving with cut parameter optimization at Ecm=350 GeV for qqqq BG.

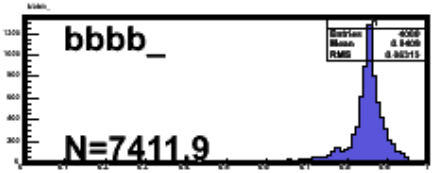
qqqq thrust dist. without chi2 cut

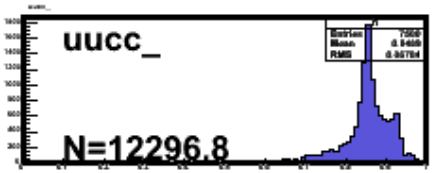


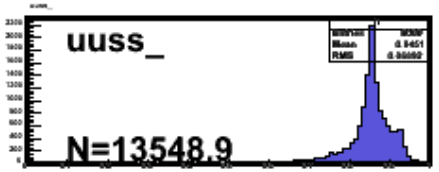


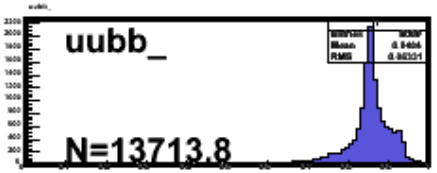


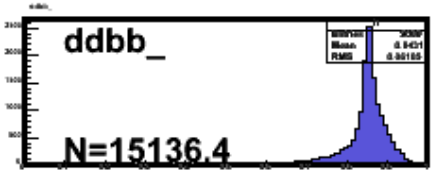


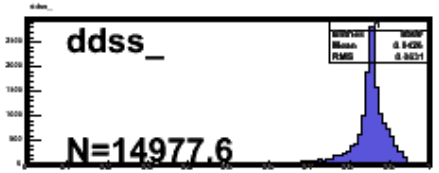


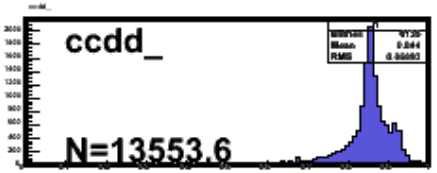


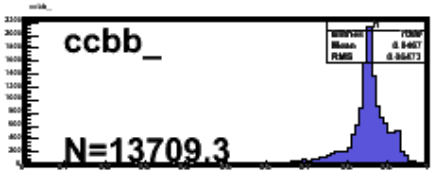


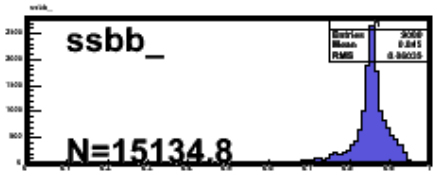


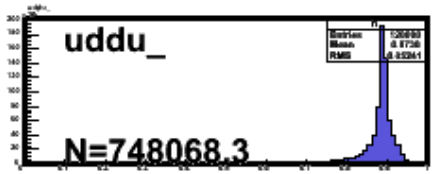


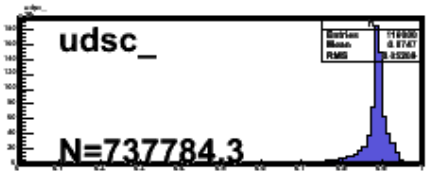


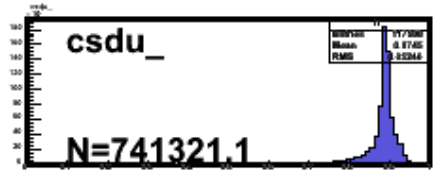


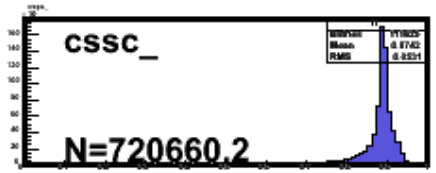






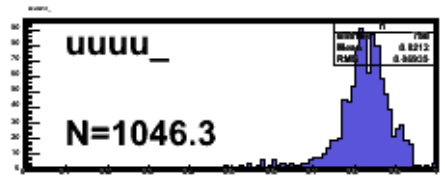


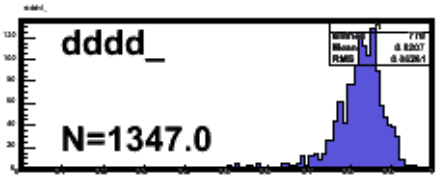


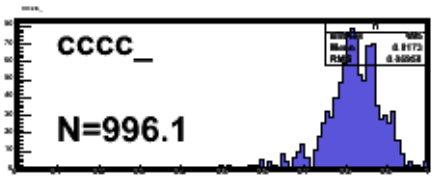


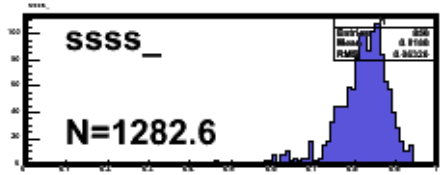
without chi2 cut
Two peak is not observed

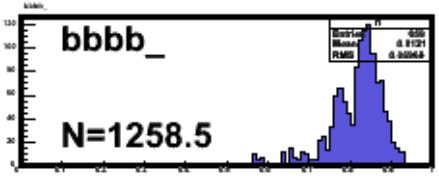
qqqq thrust dist. with chi2 cut

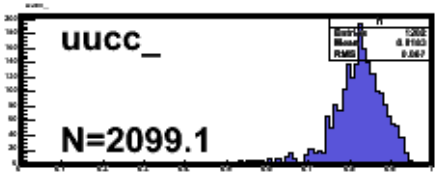


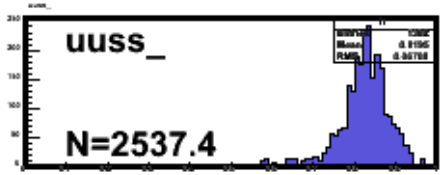


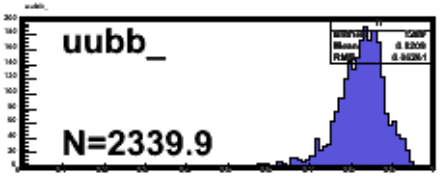


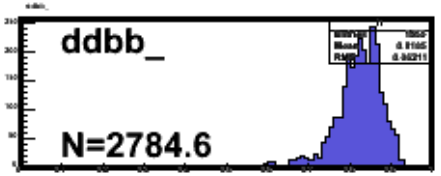


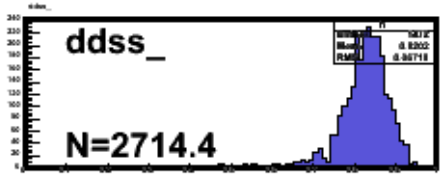


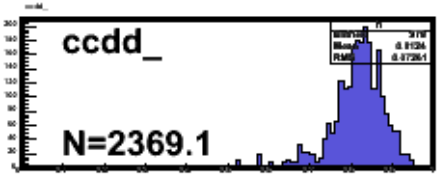


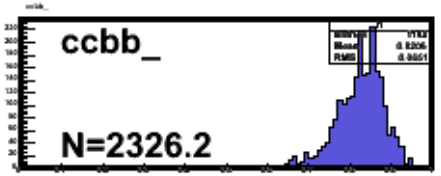


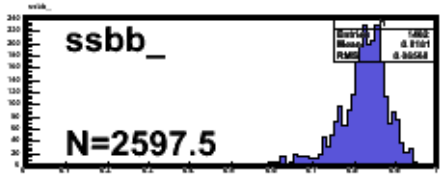


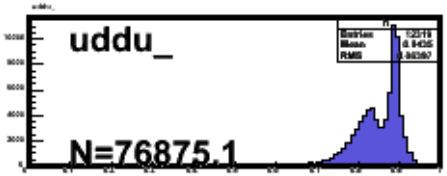


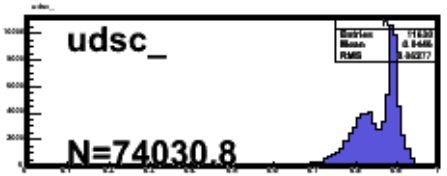


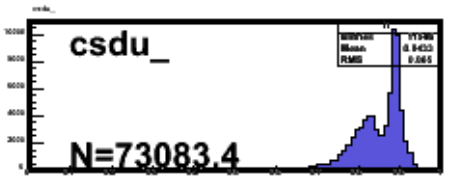


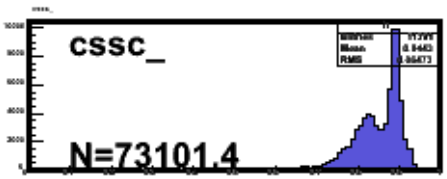










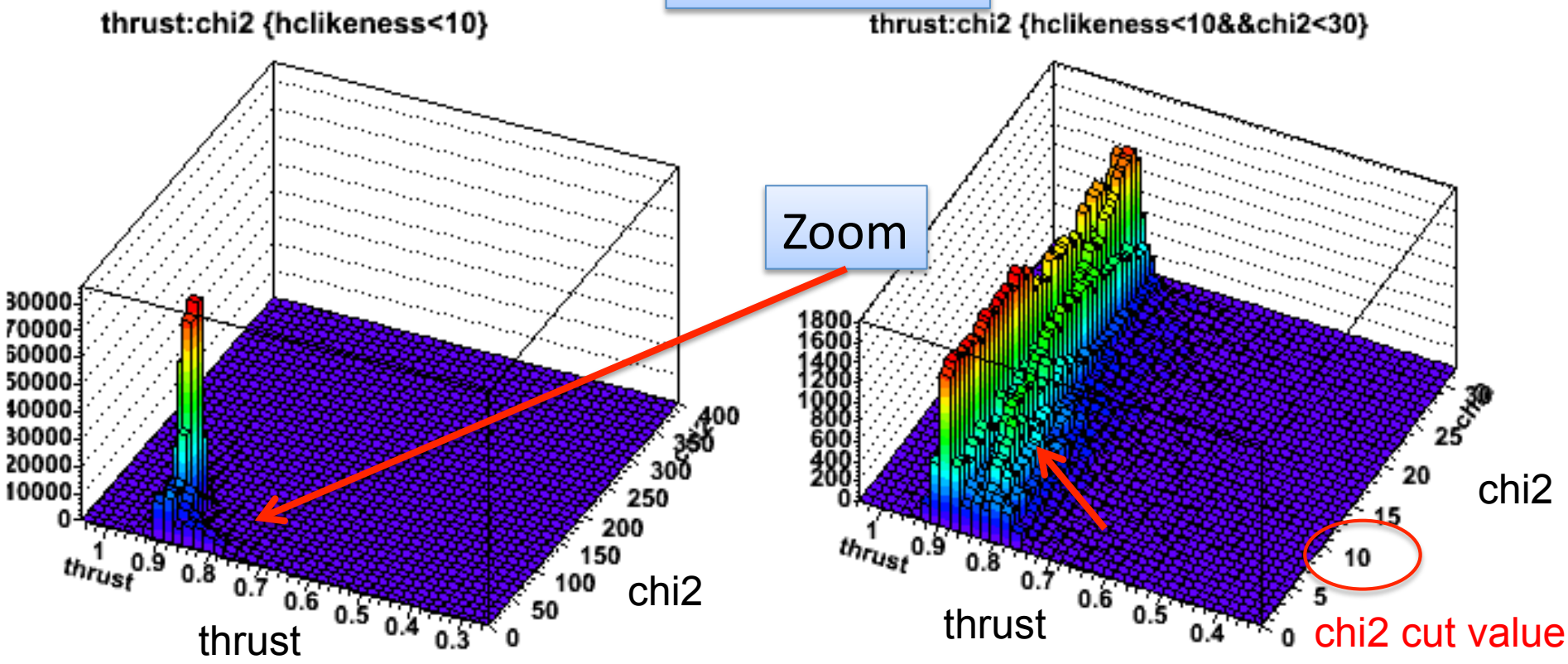


WW background makes these peak?

with chi2 cut
Some distribution has two peak

chi2 vs thrust distribution

uddu sample



Thrust peak is observed in chi2<10 region for several qqqq samples

Background reduction (ZH→qqH, 250 GeV)

250 GeV	No cuts	chi2	Ntrack	-Log (Y34)	thrust	cosθ	θH	Mh	Eff
H→cc	1916	1460	1114	1102	1081	963	890	804	41.9%
H→bb	34963	24568	19542	19351	19013	16854	15488	13651	39.0%
ZH→qqH all	52507	32430	25252	25037	24656	21856	20041	17617	33.6%
qqqq	4048390	1299950	824215	818221	814909	591276	533302	430869	10.6%
qq	35353100	1220310	296152	183403	120560	104502	88475	73790	0.2%
nlqq	4114190	25981	119	105	90	80	55	14	0.00%
llqq	398319	42195	307	252	215	158	133	87	0.02%
nnqq	149979	0	0	0	0	0	0	0	0.00%
llll	761223	20168	0	0	0	0	0	0	0.00%
SM Bkg	44825201	2608604	1120793	1002011	935788	696026	621975	504788	1.1%
BG w/o qq	9472101	1388294	824641	818608	815228	591524	533500	430998	4.6%
$S_{cc}/\sqrt{B}$	0.05	0.31	1.05	1.10	1.12	1.15	1.13	1.13	
$S_{bb}/\sqrt{B}$	0.86	5.27	18.46	19.33	19.65	20.20	19.64	19.21	

Background reduction (ZH→qqH, 350 GeV)

350 GeV	No cuts	chi2	Ntrack	-Log (Y34)	thrust	cosθ	θH	**Mh**	Eff
H→cc	1296	899	672	652	599	553	516	460	35.5%
H→bb	24051	14919	11589	11275	10410	9636	8811	7623	31.7%
ZH→qqH all	36099	20203	14905	14546	13524	12523	11191	9675	26.8%
qqqq	3094510	322790	179720	167952	85560	54839	39092	27214	0.9%
tt	166459	49314	29138	29096	28832	25962	17568	5428	3.3%
vlqq	3343060	81620	638	489	350	270	158	43	0.0%
llqq	468202	33186	235	173	90	74	51	28	0.0%
vvqq	119416	142	35	16	9	9	2	0	0.0%
llll	1074390	22722	0	0	0	0	0	0	0.0%
SM Bkg	8266030	509774	209765	197726	114841	81155	56871	32713	0.4%
$S_{cc}/\sqrt{B}$	0.45	1.26	1.47	1.47	1.77	1.94	2.16	2.54	
$S_{bb}/\sqrt{B}$	8.37	20.90	25.30	25.36	30.72	33.83	36.95	42.15	

qq samples generation is still in progress