qqH 250, status

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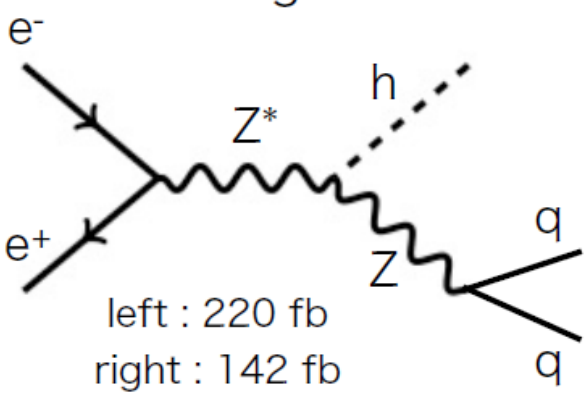
Simulation situation

Higgs mass	Ecm	Luminosity	Polarization	Detector
125 GeV	250 GeV	250 fb^{-1}	left: (-0.8, +0.3) right:(+0.8, -0.3)	ILD_o1_v05 DBD ver.

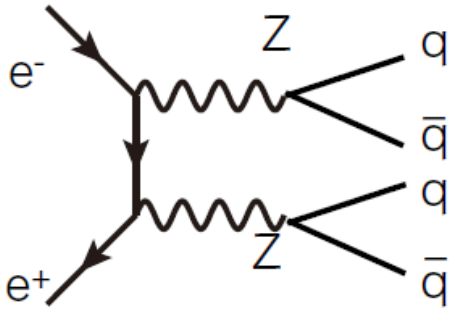
Signal



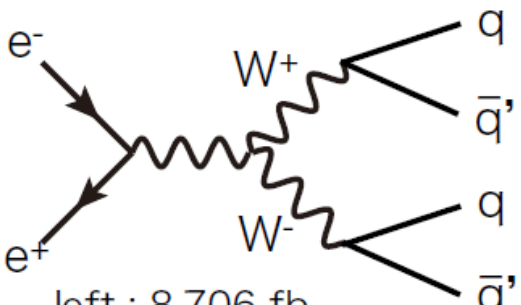
left : 220 fb
right : 142 fb

Semi-leptonic events
can also be backgrounds

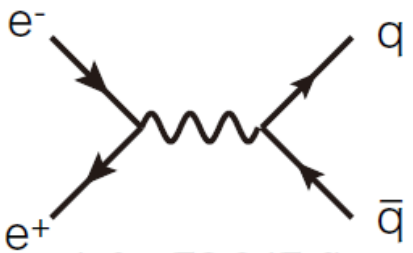
Main background



left : 841 fb
right : 403 fb



left : 8,706 fb
right : 600 fb



left : 78,047 fb
right : 46,214 fb

Analysis flow

Higgs mass	Ecm	Luminosity	Polarization	Detector
125 GeV	250 GeV	250 fb^{-1}	left: (-0.8, +0.3) right:(+0.8, -0.3)	ILD_o1_v05 DBD ver.

all PFOs

→ Iso lepton finder — remove IsoLep

→ ISR finder — remove ISR

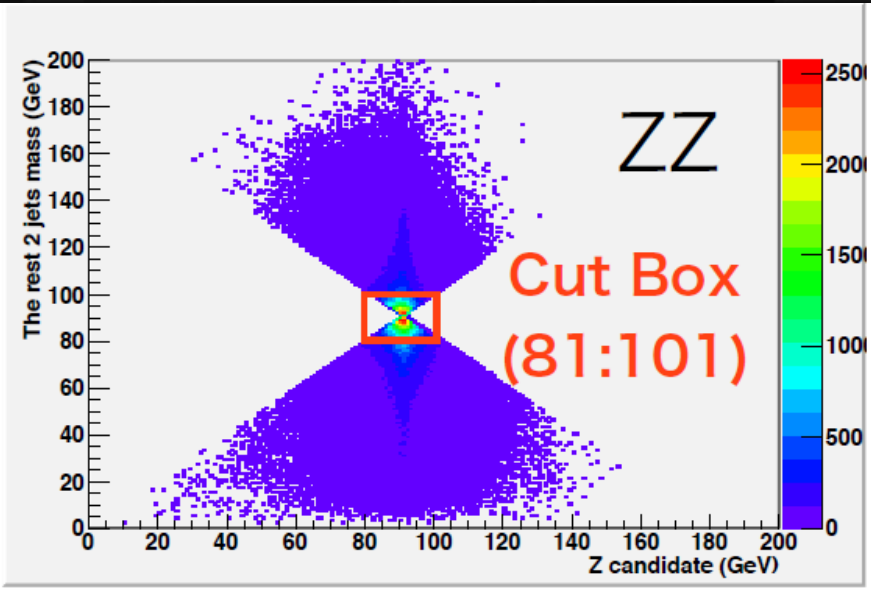
→ Tau finder — remove Tau jet

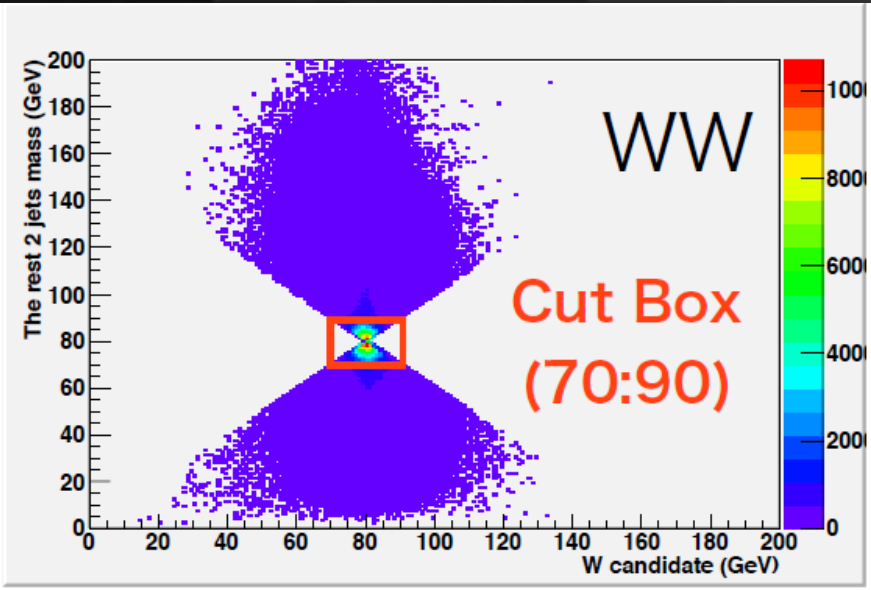
Initial State Radiation Finder
- 30 GeV && $|\cos\theta| > 0.95$
- 80 GeV && $|\cos\theta| > 0.85$
- charge == 0
- ECAL/(HCAL+ECAL) > 0.9

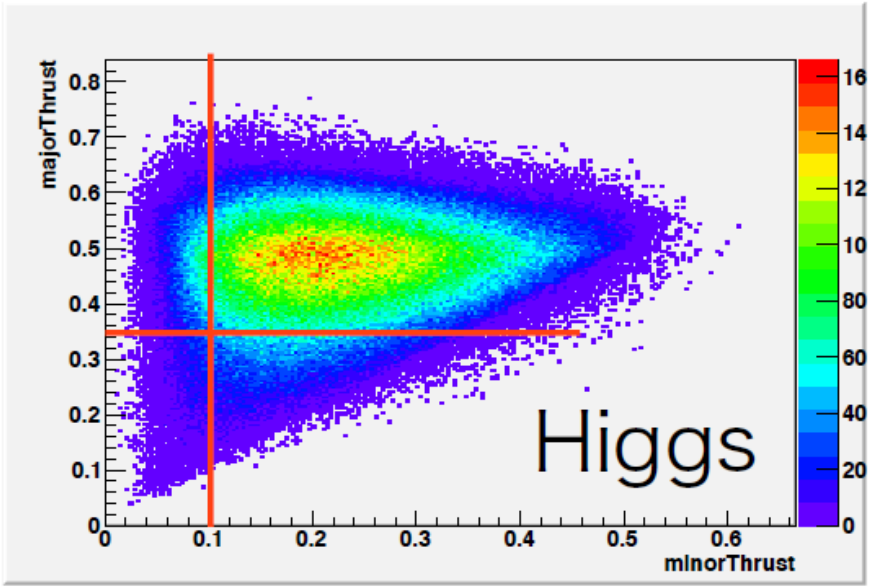
→ remaining PFOs

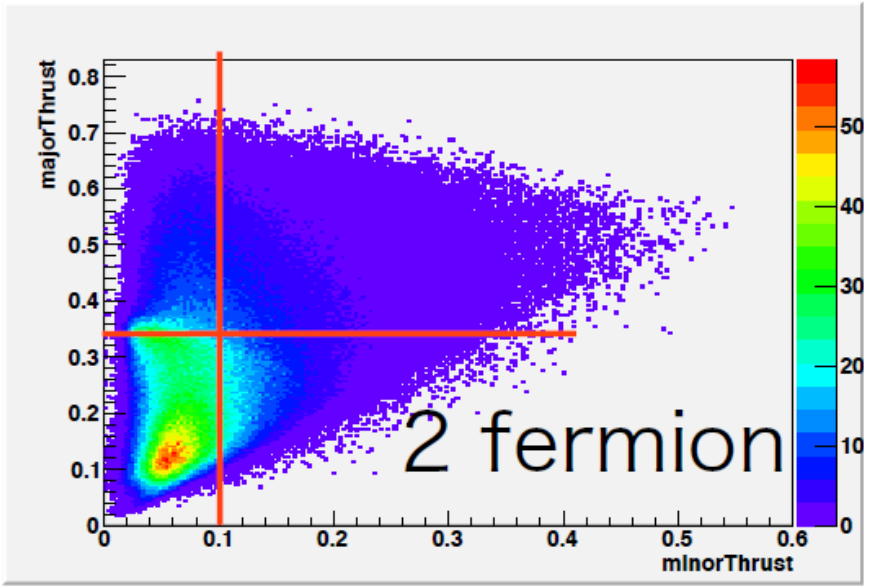
→ Durham jet clustering
2 jet, 3 jet, 4jet,
5 jet, y-value

Cuts

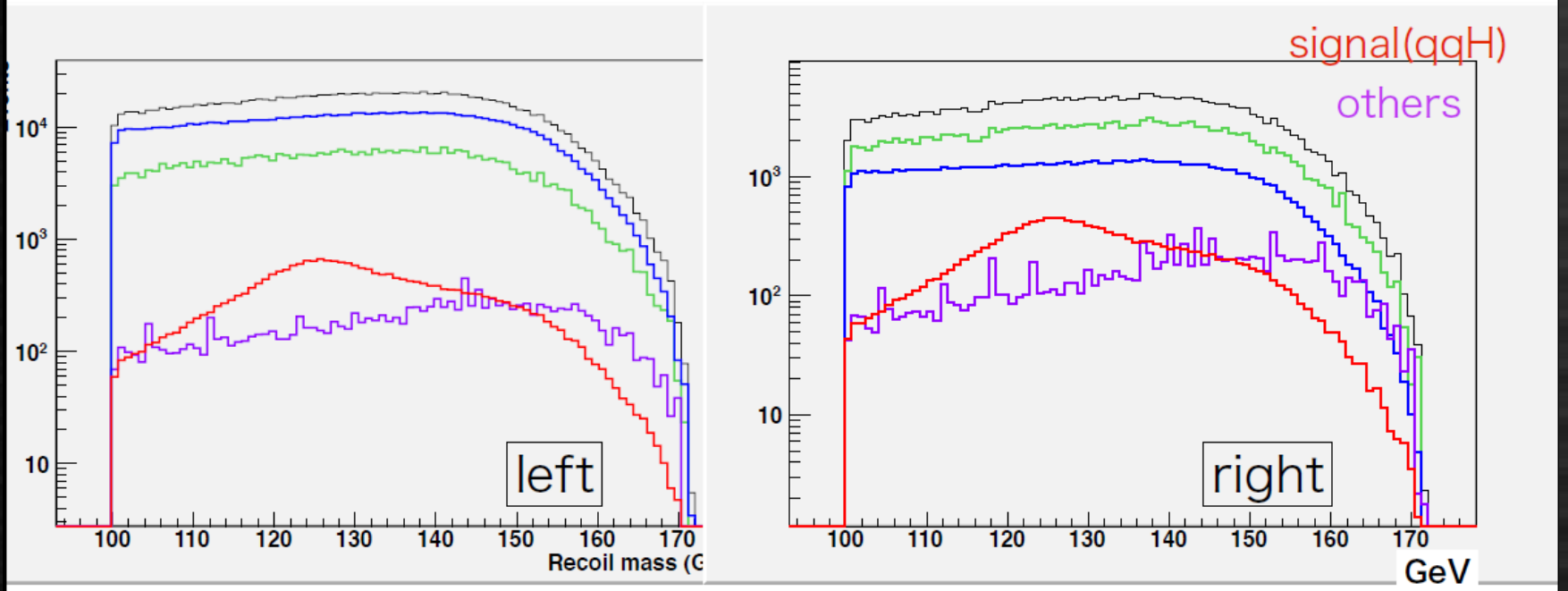

ZZ
Cut Box
(81:101)
The rest 2 jets mass (GeV)
Z candidate (GeV)


WW
Cut Box
(70:90)
The rest 2 jets mass (GeV)
W candidate (GeV)


Higgs
majorThrust
minorThrust


2 fermion
majorThrust
minorThrust

Result so far (until LCWS14)



significance was calculated in (110,150) GeV

polarization	significance	$\Delta\sigma/\sigma$
left (-0.8, +0.3)	21.5 σ	4.7%
right (+0.8, -0.3)	30.5 σ	3.3%

Background rejection not satisfactory
Significant difference of efficiency on higgs decay modes

Categorization & sum

- Powerful to improve stat. and model dep.
  - Each category features specific decay modes
  - Fraction of other category should be low
    - more allowance for difference on efficiency
  - Background should be suppressed by minimal cuts in each category
    (to minimize difference on efficiency
    and avoid to lose “exotic” Higgs decay
- Current categories based on
  - Number of leptons, taus
  - b-tagging (because of b/c/q difference)

Categories and fractions

category	0lep,0tau btag	0lep,0tau no b	0lep,1tau Evis > 180	0lep,1tau Evis < 180	0lep, ≧2tau	1lep,0tau	1lep, ≧1tau	≧2lep, ≧0tau
H->all 549,279	60.2%	21.6%	3.5%	4.6%	2.7%	5.5%	1.3%	0.75%
H->bb 57.7%	92.0%	4.8%	2.3%	0.5%	0.04%	0.33%	0.01%	~0.0%
H->WW(l) 2.3%	2.2%	6.1%	0.04%	11.4%	6.9%	24.1%	26.3%	23.0%
WW(sl) 9.5%	7.5%	22.2%	8.9%	10.9%	1.4%	45.4%	3.4%	0.2%
WW(h) 9.8%	25.4%	66.5%	6.8%	0.4%	0.3%	0.5%	0.07%	0.0%
H->gg 8.6%	26.9%	69.8%	2.7%	3.0%	0.06%	0.3%	0.01%	0.0%
H->$\tau\ \tau$ 6.3%	3.9%	8.4%	2.8%	42.9%	35.4%	2.4%	4.2%	0.1%
H->ZZ 2.6%	34.4%	43.8%	5.0%	3.4%	1.5%	3.2%	2.7%	6.0%
H->cc 2.9%	28.3%	68.0%	2.9%	0.5%	0.05%	0.3%	0.01%	0.0%
H->$\gamma\ \gamma$ 0.2%	25.3%	65.7%	3.1%	2.1%	0.5%	0.7%	0.5%	1.9%

Stat. power by minimal cuts

category	siginificance left	siginificance right	% left	% right
lep = 2, tau = any	1.7 σ	1.6 σ	59%	63%
lep = 1, tau >0	3.3 σ	3.4 σ	30%	30%
lep =1, tau = 0	3.6 σ	5.9 σ	27%	17%
lep = 0, tau >1	8.1 σ	8.9 σ	12%	11%
lep = 0, tau = 1	4.7 σ	8.3 σ	21%	12%
lep = 0, tau = 0	19.7 σ	25.5 σ	5.1%	3.9%
00 btag	38.3 σ	41.3 σ	2.6%	2.4%
00 no b	6.4 σ	8.6 σ	16%	12%
二乗和	40.3 σ	44.5 σ	2.5%	2.2%

Stat. power by likelihood

category	siginificance left	siginificance right	% left	% right
lep = 2, tau = any	1.8 σ	1.7 σ	57%	58%
lep = 1, tau >0	3.8 σ	3.5 σ	26%	28%
lep =1, tau = 0	5.9 σ	7.1 σ	17%	14%
lep = 0, tau >1	8.4 σ	8.1 σ	12%	12%
lep = 0, tau = 1	6.5 σ	8.1 σ	15%	12%
00 btag	34.1 σ	35.9 σ	2.9%	2.8%
00 no b	7.9 σ	11.8 σ	13%	8.5%
二乗和	37.3 σ	40.3 σ	2.7%	2.5%

Stat. power by BDT

category	siginificance left	siginificance right	% left	% right
lep = 2, tau = any	2.2 σ	1.9 σ	45%	52%
lep = 1, tau >0	4.3 σ	3.5 σ	24%	28%
lep =1, tau = 0	5.5 σ	4.1 σ	18%	25%
lep = 0, tau >1	11.4 σ	11.9 σ	8.8%	8.4%
lep = 0, tau = 1	7.2 σ	10.5 σ	14%	9.5%
00 btag	52.0 σ	56.7 σ	1.9%	1.8%
00 no b	8.3 σ	11.8 σ	12%	8.5%
二乗和	54.8 σ	60.3 σ	1.8%	1.7%

Tuned for stat. power – efficiency difference larger

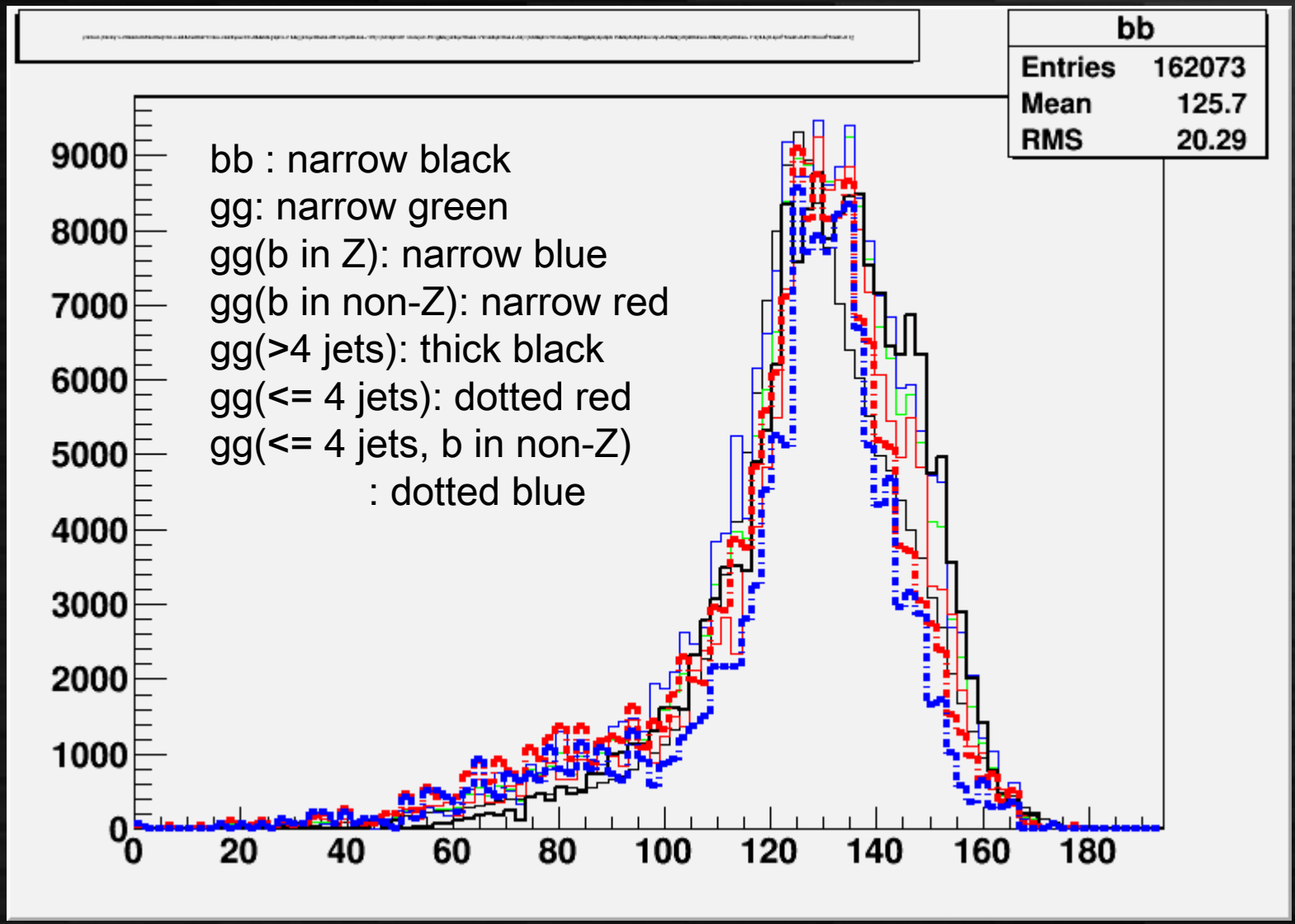
Efficiency difference

category	0lep,0tau btag	0lep,0tau no btag	0lep,1tau	0lep,1tau	0lep,≧2tau	1lep,0tau	1lep,≧1tau	≧2lep, ≧0tau
H->all	−−	−−	−−	−−	−−	−−	−−	−−
H->bb	-0.6%	-0.1%	-0.2%	-0.03%	~0.0%	-0.05%	~0.0%	~0.0%
H->WW(l)	+0.5%	+0.9%	~0.0%	-0.3%	-0.2%	-0.9%	-0.8%	-0.05%
WW(sl)	-0.1%	-2.7%	-0.2%	-0.9%	-0.2%	+0.7%	-0.2%	+0.02%
WW(h)	+0.7%	+0.9%	+0.9%	+0.1%	+0.03%	-0.07%	~0.0%	~0.0%
H->gg	+4.1%	+3.7%	-0.2%	+0.08%	~0.0%	-0.05%	~0.0%	~0.0%
H->$\tau\,\tau$	-0.3%	-1.7%	-0.3%	+0.5%	-0.3%	+0.02%	-0.2%	-0.02%
H->ZZ	+1.2%	-0.2%	-0.6%	+0.3%	-0.1%	-0.3%	+0.4%	+0.4%
H->cc	-3.8%	+1.1%	-0.4%	-0.2%	~0.0%	-0.08%	~0.0%	~0.0%
H->$\gamma\,\gamma$	+0.2%	-4.0%	+1.0%	-0.1%	+0.1%	-0.4%	+0.2%	+0.6%

偏極	シグナル強度	測定精度の誤差
left (-0.8, +0.3)	40.3 σ	2.5%
right (+0.8, -0.3)	44.5 σ	2.2%

Not enough, but OK if assuming “SM-like” branch

Recoil mass plot at 0/0/b category



Summary

- Goal: ~2% with model independency
- Categorization is very powerful
- ~2% seems realistic now
- Bias still large with no assumption of BR
  → should improve
- Bias acceptable for SM-like BRs
- Should carefully check the discovery of deviation with many models
  - BR is not changed (just total cross section is affected)
  - specific BR is only deviated
  - exotic decay??? (how?)