Higgs recoil mass study using qqH @ 250 GeV ILC

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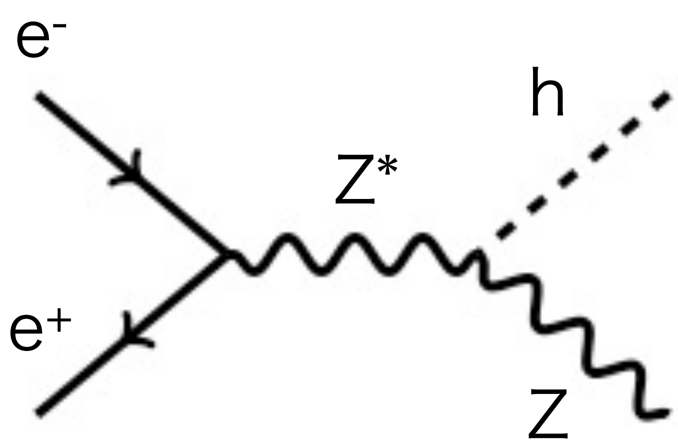
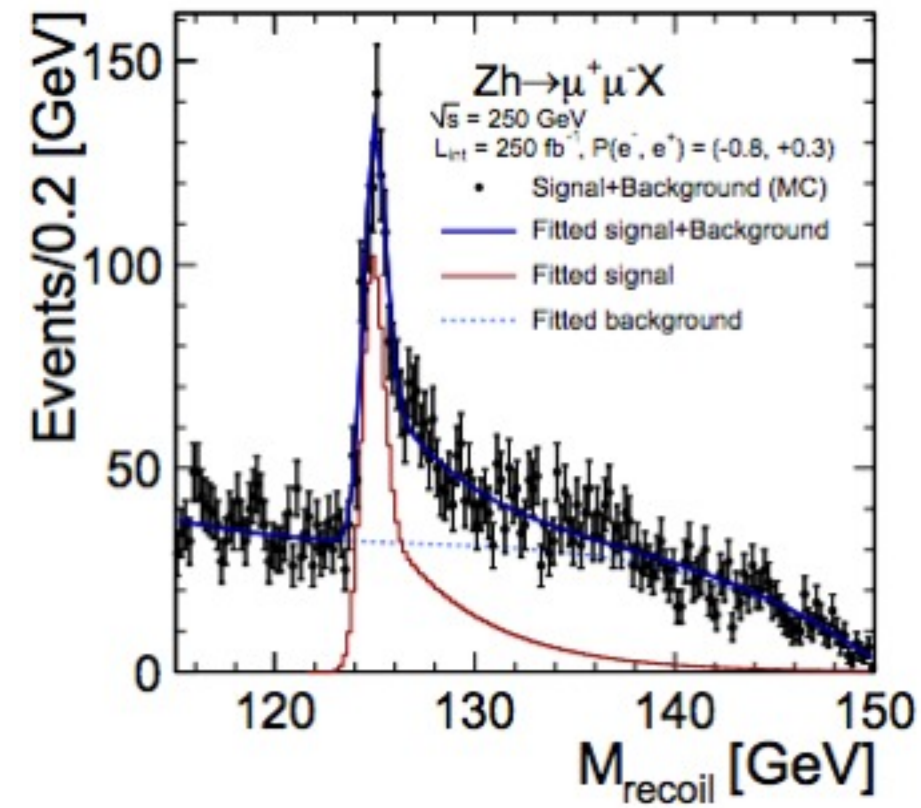
qqH channel



In recoil mass study, leptonic channel such as Z -> e^+e^-, mu^+mu^- has very good signal/background ratio.

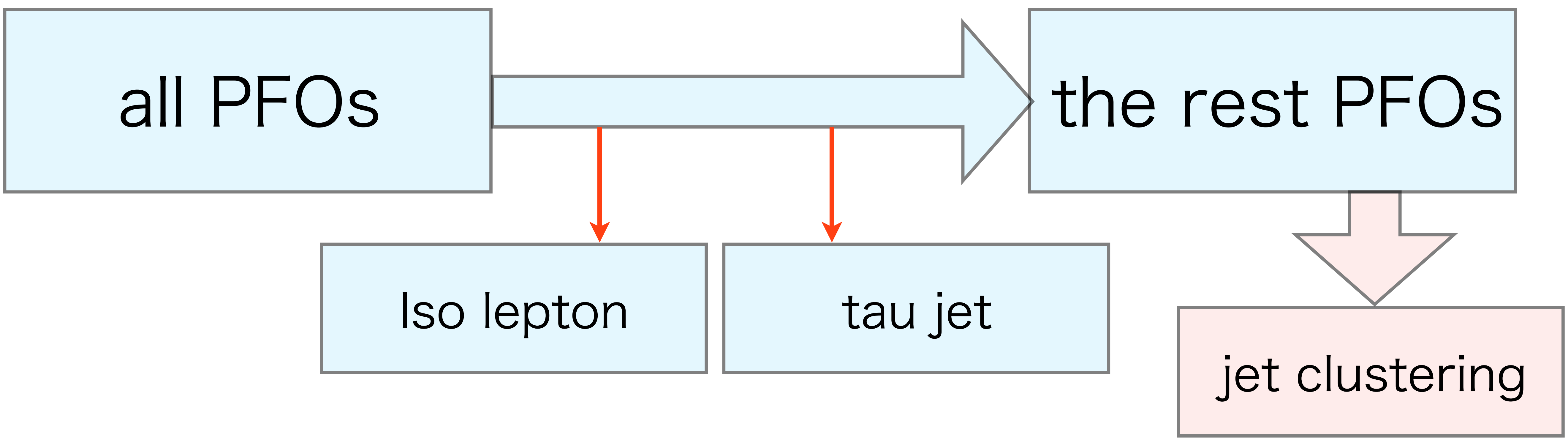


But, the branching ratio of Z -> leptonic is ~3.5% for each generation.

On the other hand, the branching ratio of **Z -> hadronic is ~70%**.

data list and method

- All DBD sample under the /hsm/ilc/grid/strom/prod/ilc/mc-dbd/ild/dst/250-TDR_ws/ was used.
- Before jet clustering, we removed isolated lepton and tau jet using Isolep/taujet finder.



- We clustered the rest PFOs with 2-jet, 4-jet, and y-value fix clustering.

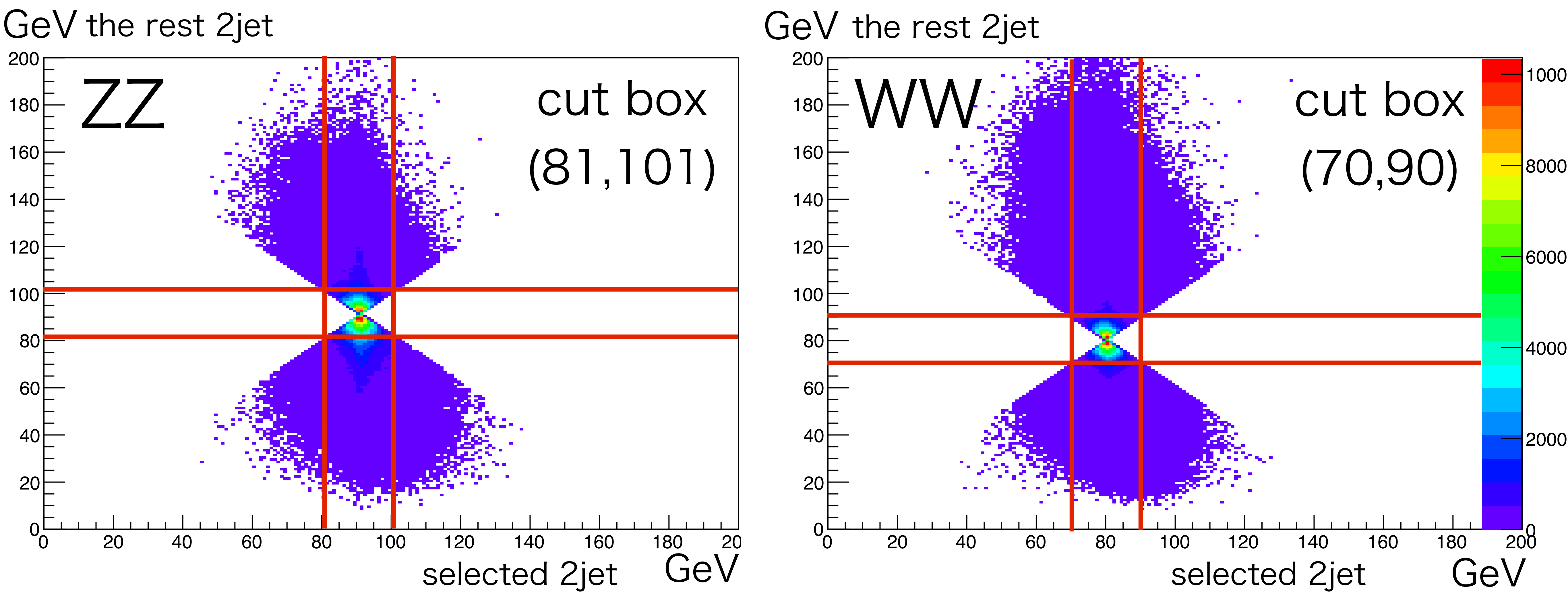
Background estimation(4-jet clustering)

In 4-jet clustering, our main target BGs are ZZ/WW-> hadronic.

At first, we reconstruct the mass of every pair.

And record the mass that has smallest value in the formula of

$(\text{ZorW mass - dijetmass})^2$.

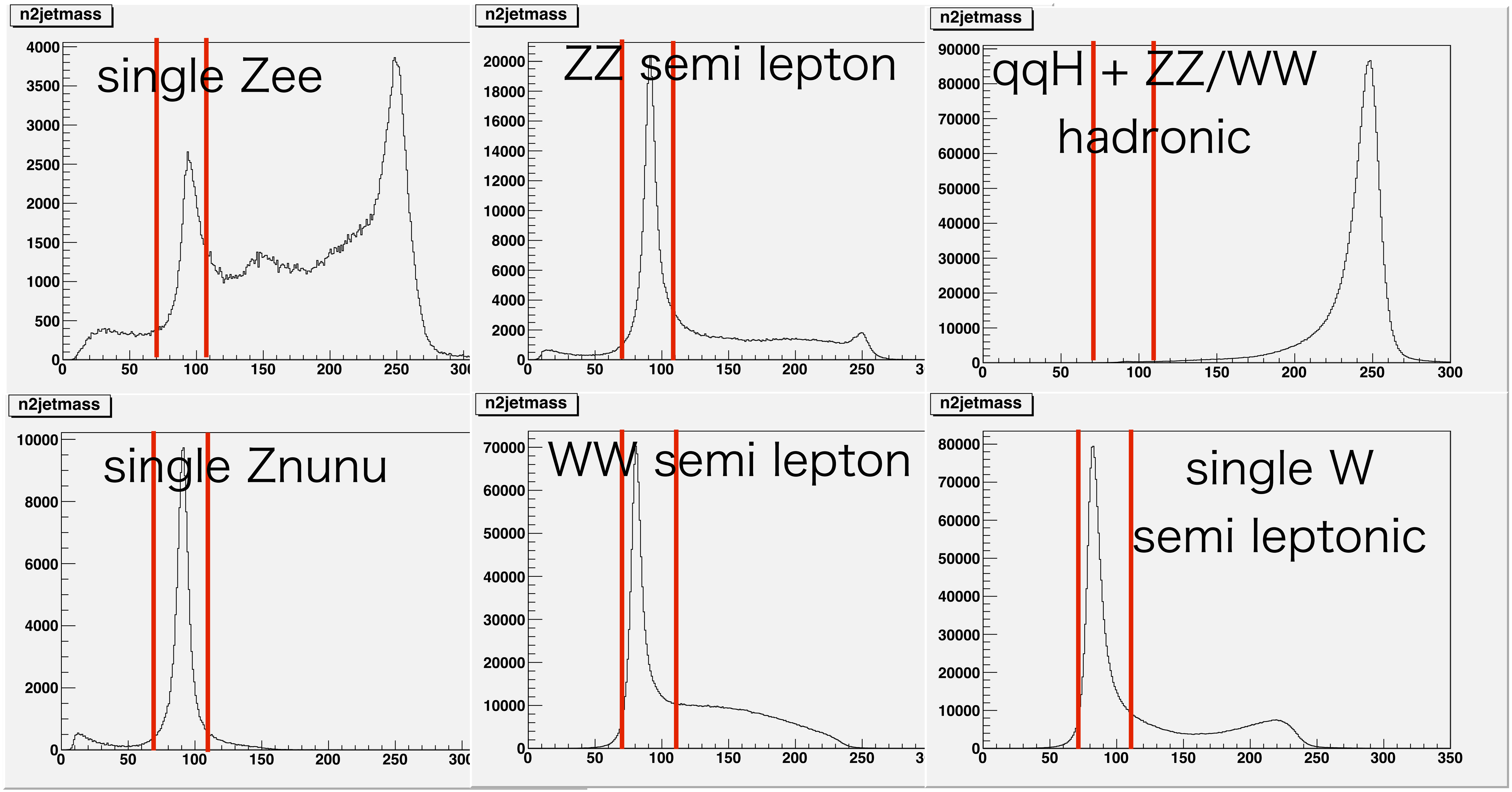


After applying cut, ZZ reduced 50% and WW reduced 60%.

Background estimation(2-jet clustering)

In 2-jet clustering, our main target BGs are semi leptonic modes.

ZZ -> qqll (l != τ), qqnn, WW -> qlν (l != τ)



Cut region set is (70,110)

y value fix clustering

We used y-value clustering for higgs recoil mass study.

$$y = \frac{2\mathrm{min}(E_i^2, E_j^2)(1-\cos\theta_{ij})}{Q^2}$$

In this time we fix the y-value at 0.005

After clustering, we searched the 2 jet nearest Z mass

and then calculate recoil mass using four momentum conservation

$$m^2_{\mathrm{recoil}} = (\sqrt{s} - E_Z)^2 - \mid \vec{p}_Z \mid^2$$

recoil result(left handed)

recoil result(right handed)

efficiency inconsistent(left handed)

mode	before	ZZ	WW	ZZWW	recoil	efficiency
H->all						
H->bb						
H->WW						
H->gg						
H->$\tau\tau$						
H->ZZ						
H->cc						
H->$\gamma\gamma$						

strategy for resolving efficiency issue -1

To resolve efficiency inconsistent issue, we will categorize events using
- the number of jets (2, 3, 4, and more than 5)
- the number of iso lepton (0, 1, and more than 2)

tau jet will also be included with iso lepton

After that, we optimize cut to arrange efficiency for major category.

For minor category, if the ratio of such category is enough small, we don't care about that.

Finally, we take account of each category efficiency, and then combine all category to one.

strategy for resolving efficiency issue -2

mode	2jet,0lep	2jet,1lep	2jet,>2lep	3jet,0lep	3jet,1lep	3jet,>2lep
H->all						
H->bb						
H->WW						
H->gg						
H->$\tau\tau$						
H->ZZ						
H->cc						
H->$\gamma\gamma$						

strategy for resolving efficiency issue -3

mode	4jet,0lep	4jet,1lep	4jet,>2lep	>5jet,0lep	>5jet,1lep	>5jet,>2lep
H->all						
H->bb						
H->WW						
H->gg						
H->$\tau\tau$						
H->ZZ						
H->cc						
H->$\gamma\gamma$						

One example (4-jet, 0-lepton)

mode	before	ZZ	WW	ZZWW	recoil	efficiency
H->all						
H->bb						
H->WW						
H->gg						
H->$\tau\tau$						
H->ZZ						
H->cc						
H->$\gamma\gamma$						

result with 4-jet, 0-lepton(left handed)

Summary and Prospects

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The result of 2-jet mass cut

	4f Zee semi lep	4f ZZ semi lep	4f Znunu semi lep	4f WW semi lep	4f W semi lep
before cut	78,394	372,315	138,970	1,047,659	564,745
after cut	5,022	28,675	3,368	226,443	97,007
%	6.4%	7.7%	2.4%	21.6%	17.2%

for WW, this cut is not so powerful…
but for ZZ, this is a big progress.