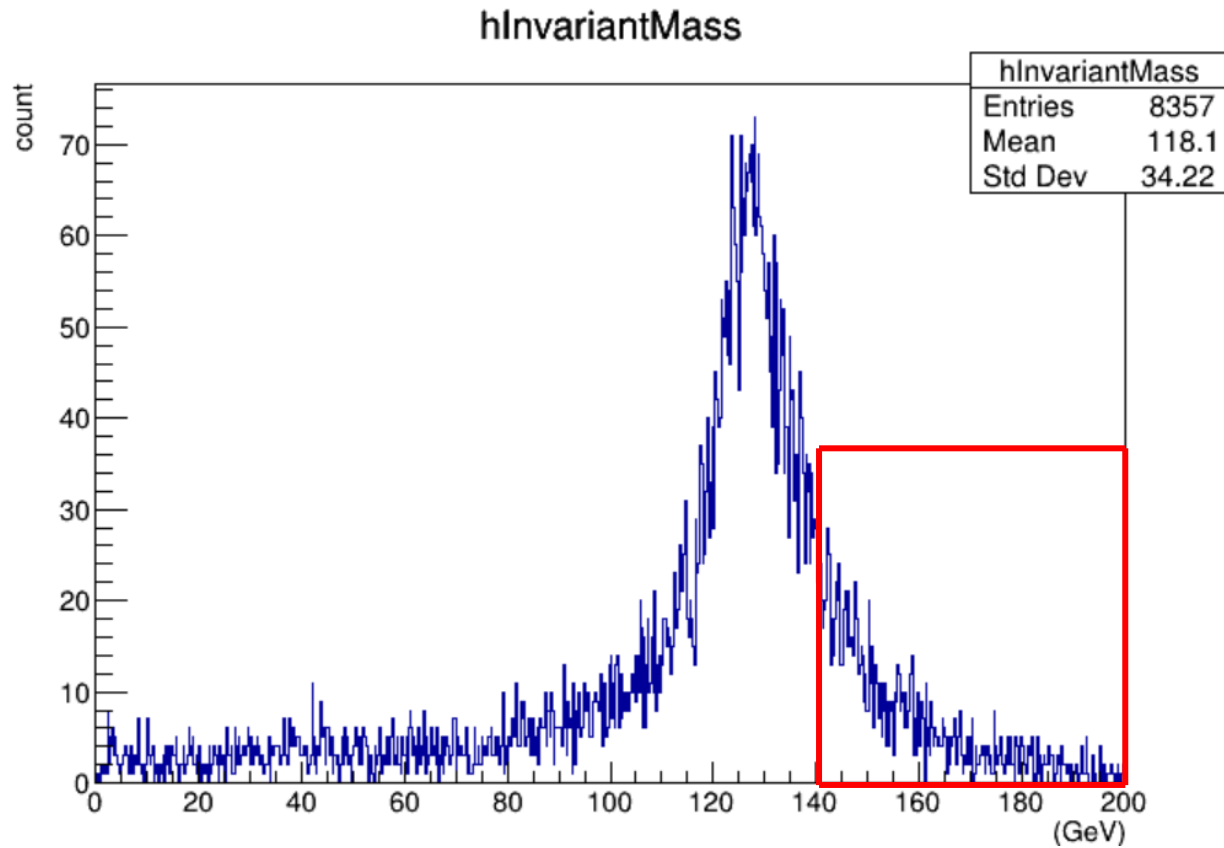# Higgs to ss study

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Jet clustering (PandoraPFOs)

The data was reconstructed with two jets forced, except for the two identified leptons. (signal event)

Used data：rv02-02.sv02-02.mILD_l5_o1_v02.E250-SetA.I402004.Pe2e2h.eR.pL.n000.d_dstm_15089_0.slcio

This graph shows the jet mass distribution for the signal event using the steering file before it changed.
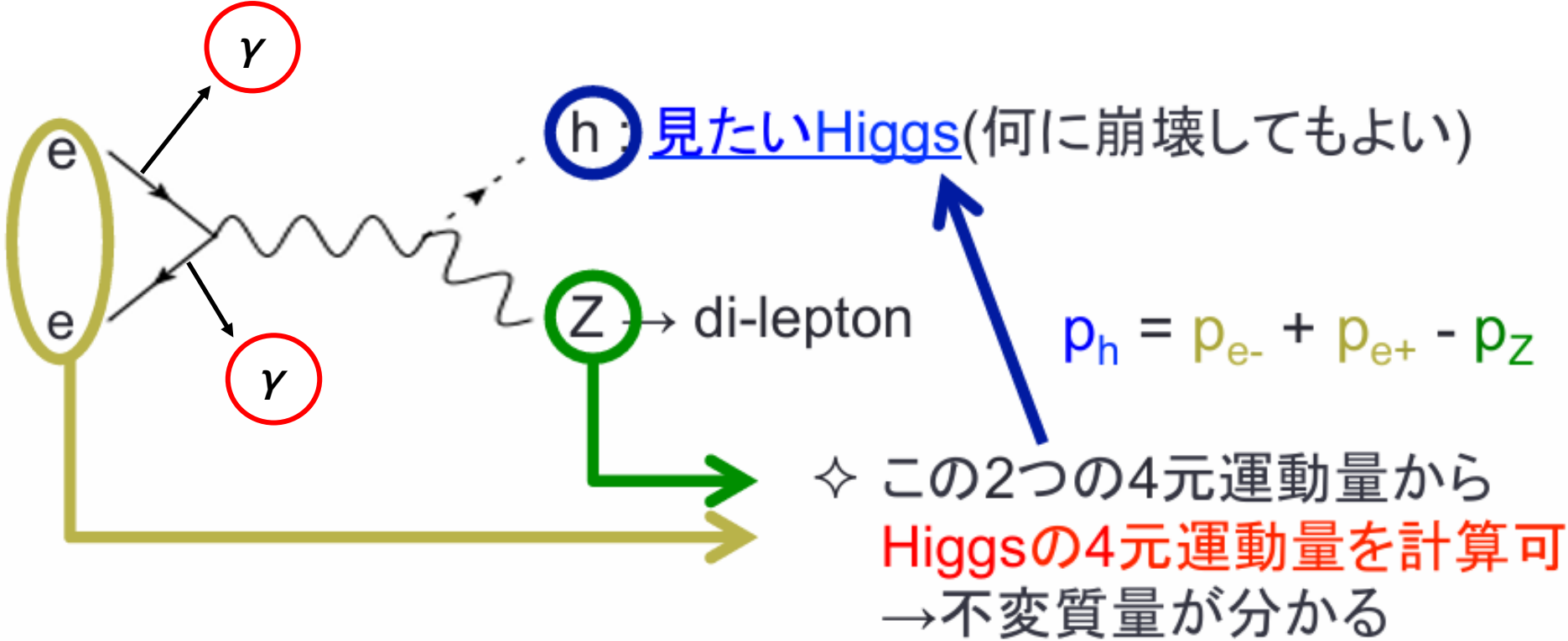
There are more events above 140 GeV than expected.

Consider that electrons and positrons drop photons before collisions

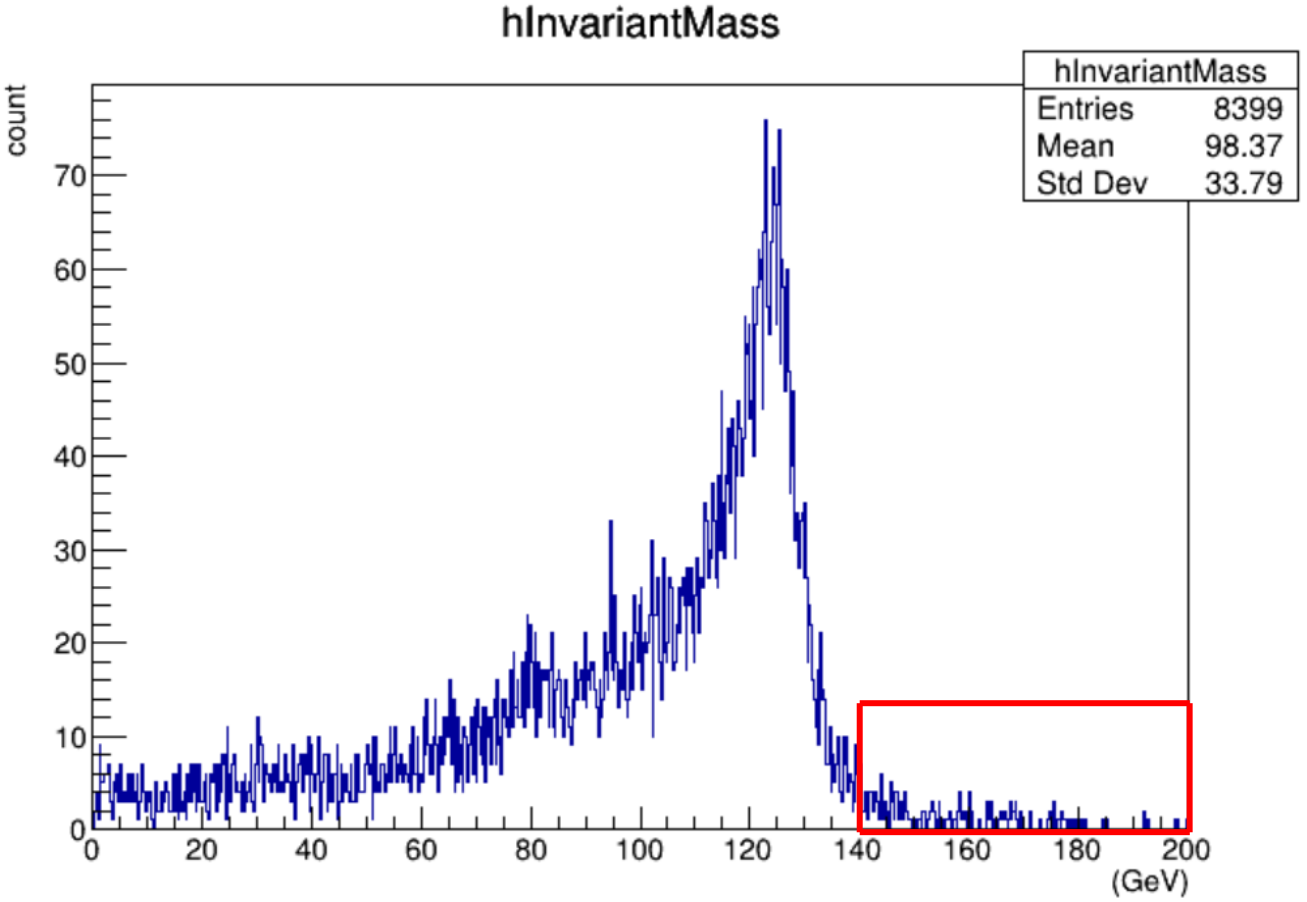To account for energy loss before impact

The following sentence was added to the Jet Clustering steering file.

$p_h = p_{e-} + p_{e+} - p_Z$

h：見たいHiggs(何に崩壊してもよい)

Z → di-lepton

✧ この2つの4元運動量から
Higgsの4元運動量を計算可
→不変質量が分かる

Consideration (Di-Jet Mass)

This graph shows the jet mass distribution for the signal event and the jet mass of the signal event when considering photons

The number of events above 140 GeV was considerably reduced after taking photons into account.

To find out what is above 140 GeV, the Higgs boson was divided into different types of decaying particles.

About the Cut

CM energy (GeV)		250		
Cut names	e/μ	condition	Sig.	Bkg.
Generated	e		3137	4512520
	μ		2917	4512520
# of e/μ track ID	e	$N_e >= 2$	2717	204403
	μ	$N_\mu >= 2$	2668	28175
Di-lepton mass (GeV)	e	$70 < M_{\ell\ell} < 110$	2208	34162
	μ	$80 < M_{\ell\ell} < 110$	2287	12901
Z direction	e	$|\cos\theta| < 0.8$	1797	21600
	μ	$|\cos\theta| < 0.8$	1889	8036
Di-jet mass (GeV)	e	$100 < M_{jj} < 140$	1394	2721
	μ	$115 < M_{jj} < 140$	1445	1955
Recoil mass (GeV)	e	$70 < M_{rec} < 140$	1184	1607
	μ	$70 < M_{rec} < 140$	1365	983
Significance (Efficiency)	e	$S/\sqrt{S+B}$	22.4 (37.8%)	
	μ		28.2 (46.8%)	

- Muon identification by calorimeter information

- Cutting of lepton masses to match Z masses

- Cutting in the Z direction for BGremoval of

  bosons

- Cutting jets to match Higgs mass

- Cut recoil masses to lepton pairs

These cuts were made for muon events

reference document: H.Ono 「Evaluation of measurement accuracies of the Higgs boson branching fractions in the International Linear Collider」

The result of the cut on each signal event

$$Normalized\ Events = Events \times \frac{CrossSection}{Generated} \times Luminosity \qquad (Luminosity = 250\ fb^{-1})$$

Aside from the other events, the b-quark events are also considerably reduced by the jet cut.

cut name	reference	b	c	g	others	all	normalized
Generated	2917	4853	257	647	2462	8219	2717
track ID	2668	4490	244	591	2357	7682	2539
Di-lepton mass (GeV)	2287	4156	226	546	1610	6538	2161
Z direction	1889	3395	184	447	1324	5350	1768
Di-jet mass (GeV)	1445	1771	129	247	254	2401	793
Recoil mass (GeV)	1365	1550	116	223	218	2107	696

Variation of the jet mass distribution of the ZZsemi leptonic

The energy loss of the electron-positron before collision is taken into account.
There are blatantly fewer events above 140 GeV.
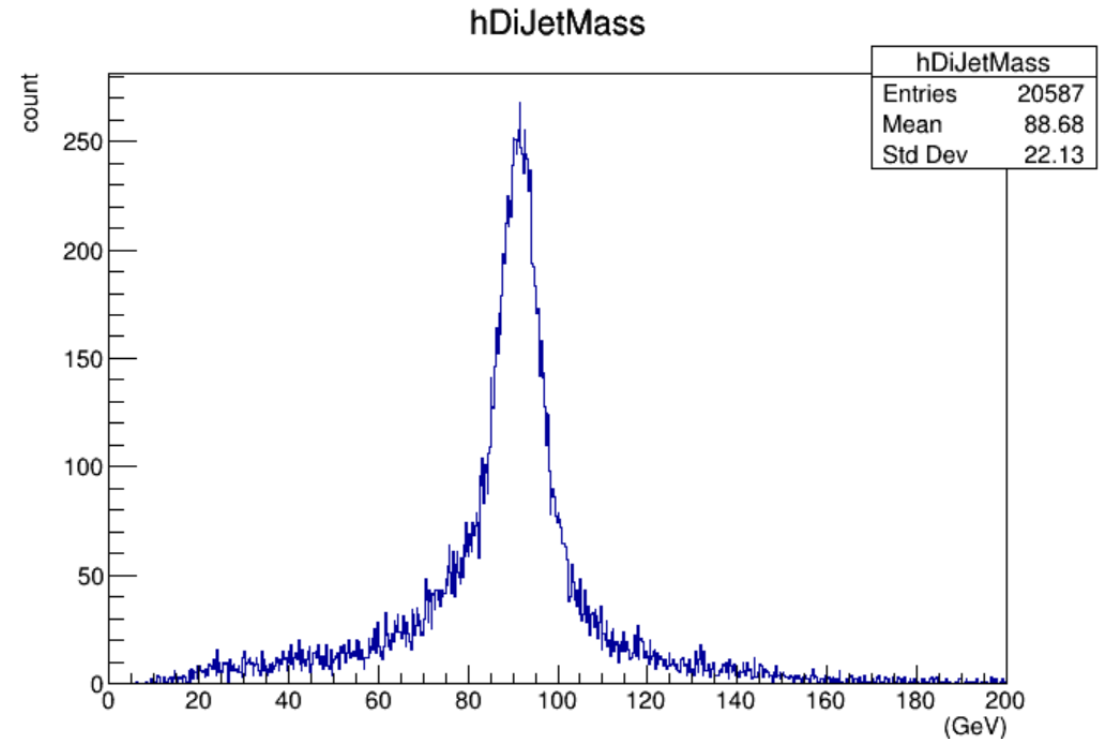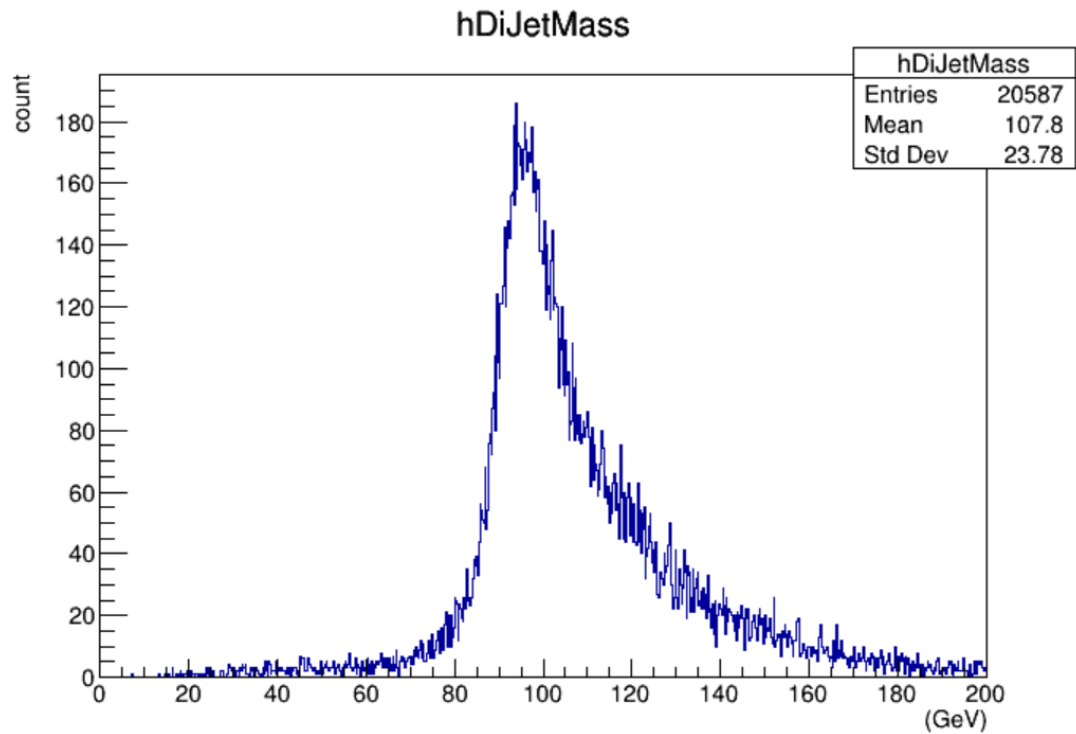
The result of the cut on each BG event

DiJetMass removed most of the background.

| 規格化						
cut name	BGお手本	ZZsemi	WWsemi	ZZlepton	WWlepton	合計
Generated	45122520	209519	4694775	22239	390855	5317389
track ID	28175	19749	443	1861	4834(+141)	26889(+141)
Di-lepton mass (GeV)	12901	12277	104	1323	1441(-123)	15146(-123)
Z direction	8036	7620	78.24625	509	995(-79)	9204(-79)
Di-jet mass (GeV)	1955	375(-1045)	0	8(-9)	0	383(-1055)
Recoil mass (GeV)	983	303(-1018)	0	5(-7)	0	308(-1025)
cross section		838.079 fb	18779.1 fb	88.9574 fb	1563.42 fb	

() is difference from Before Change

Next

- View the distribution by changing the alpha parameter from 1.0 to 1.6

- Start analysis of hadronic processes
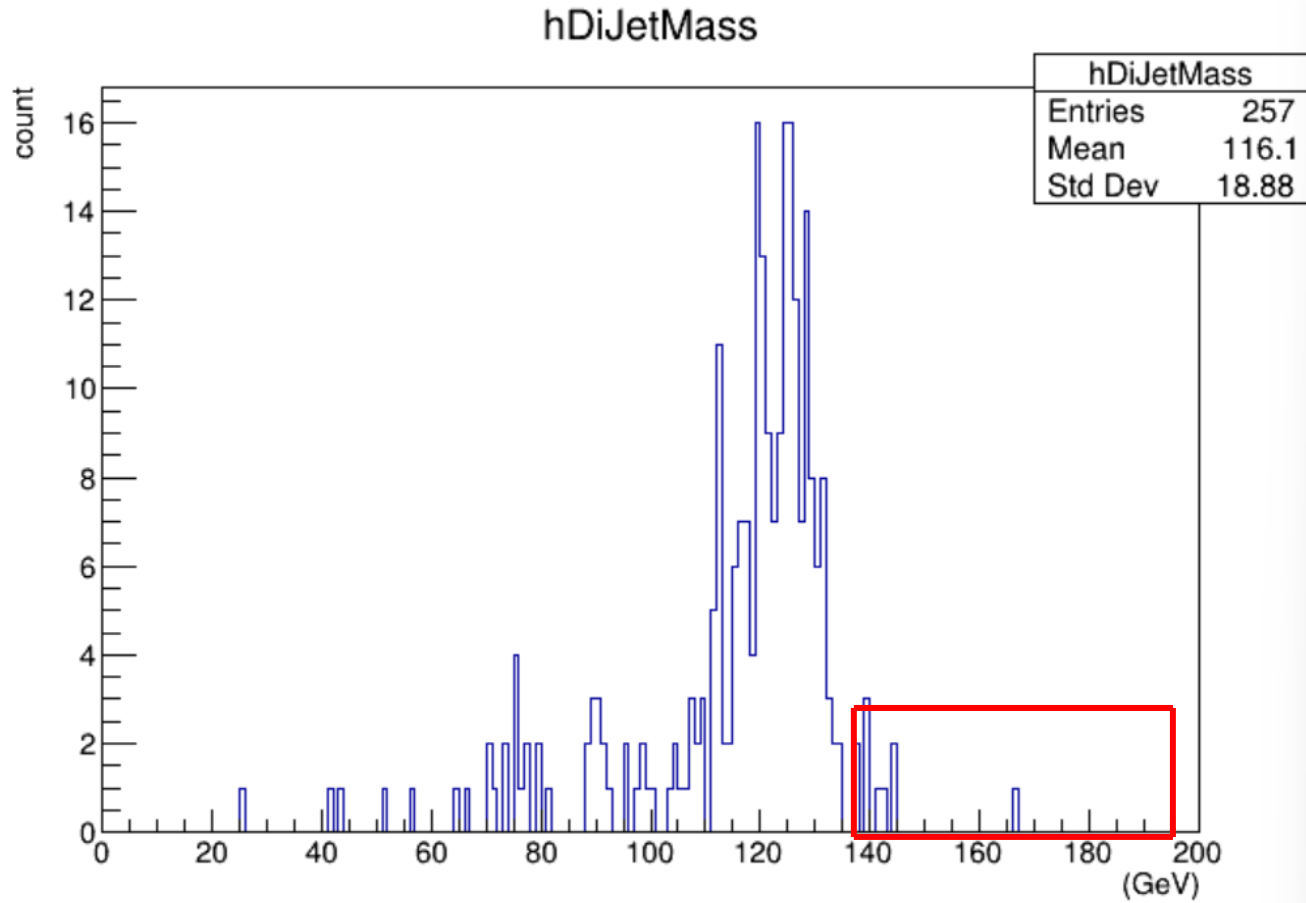
Back Up

b quark jet mass   H→bb (58%)
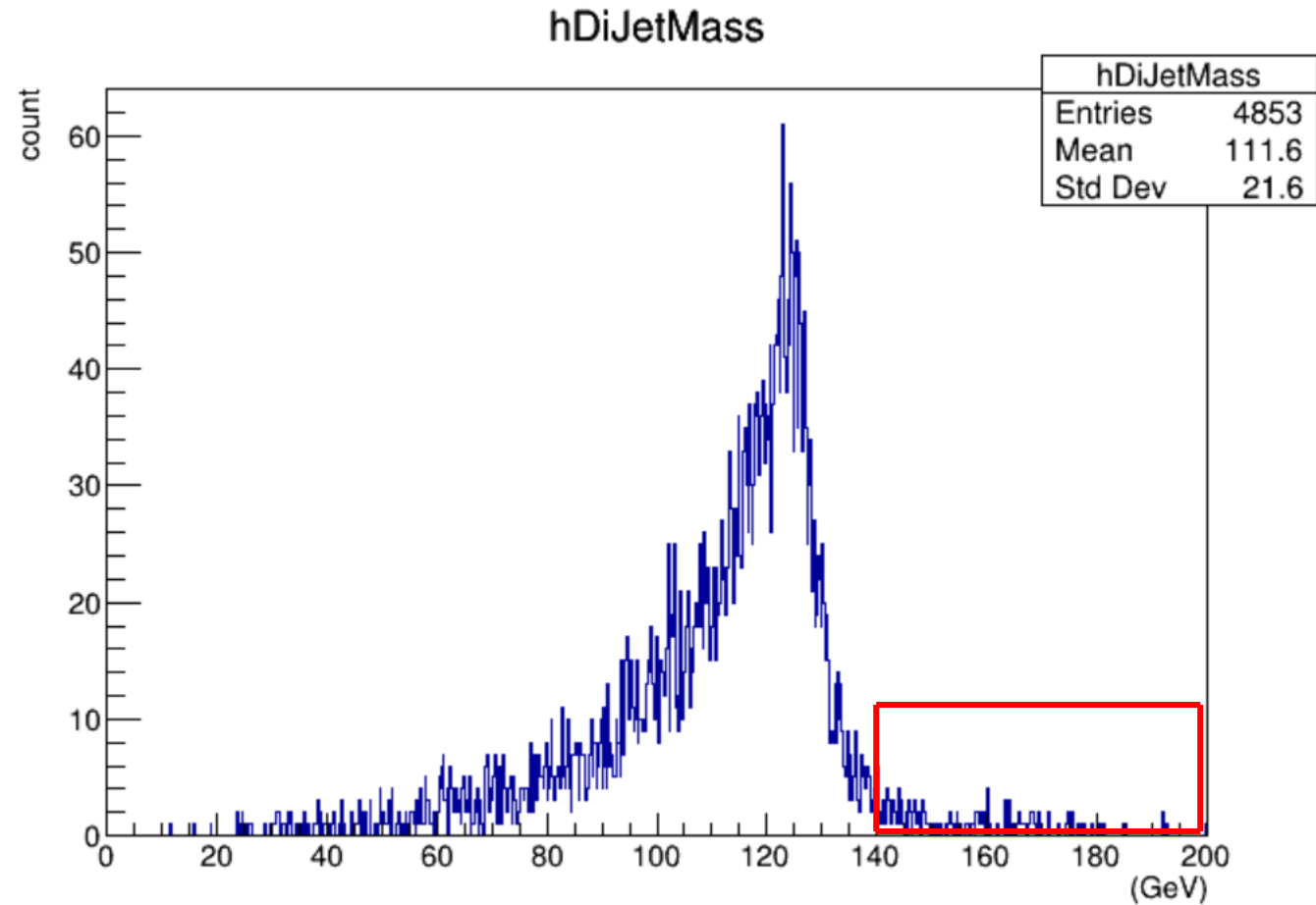
This graph shows the jet mass distribution for the event in which the Higgs boson decays into b quarks.

This graph contains a few grain events above 140 GeV

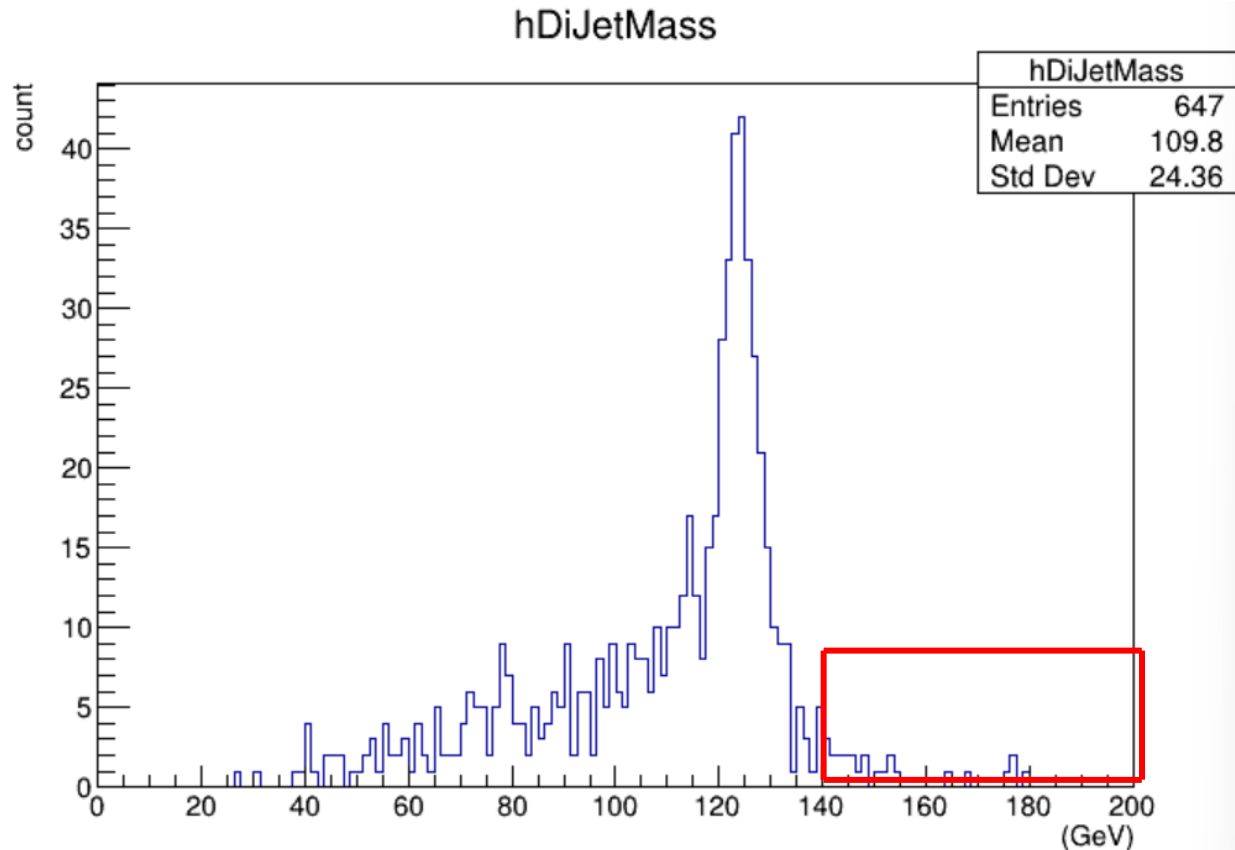# c quark jet mass   H→cc (3%)

This graph shows the jet mass distribution for the event in which the Higgs boson decays into c quarks.

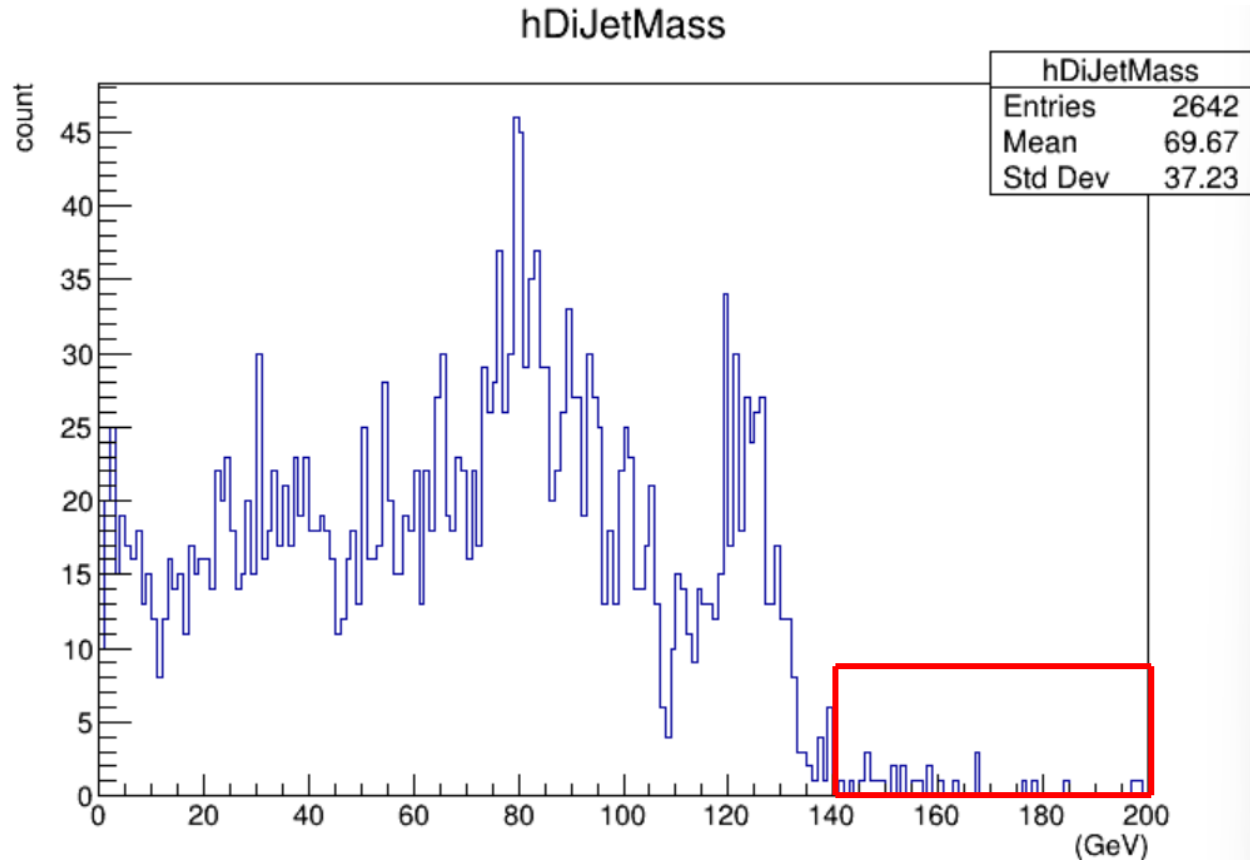This graph shows that there are not many grain events above 140 GeV

gluon jet mass H→gg (8%)

This graph shows the jet mass distribution for the event in which the Higgs boson decays into gluon.

This graph shows that there are not many grain events above 140 GeV

Others jet mass　　　(**31%**)

This graph shows the jet mass distribution for the event in which the Higgs boson decays into others.

This graph contains a few grain events above 140 GeV