Update of vvh @ 1 TeV study

ILD analysis meeting
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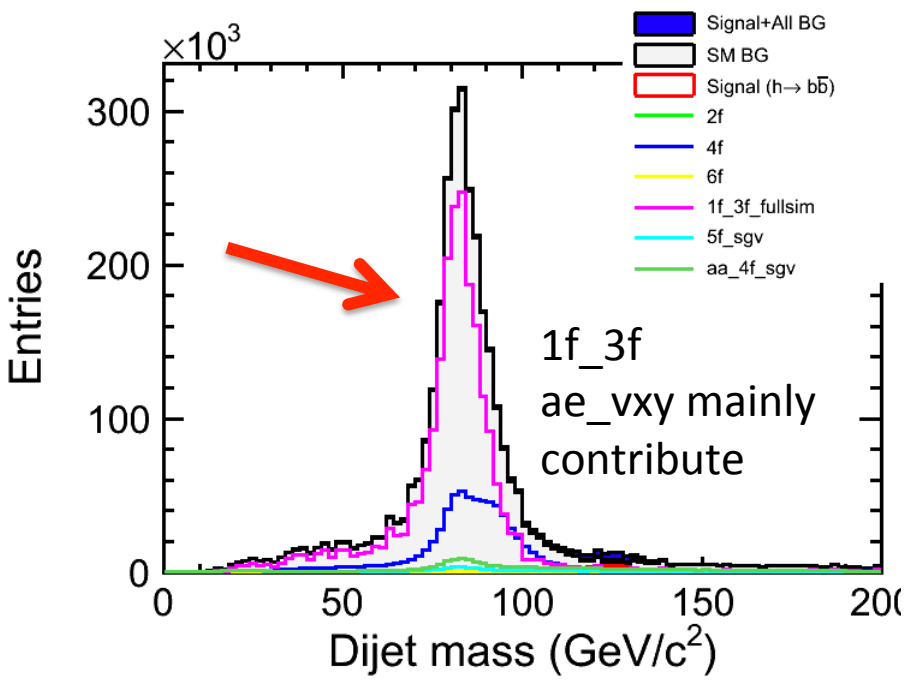
Current status of vvh study

- SiD completely gave 500 fb-1 (-+0.8,+-0.2) results and 1 ab-1 data too.
- We still have difference between ILD and SiD
- ILD analysis does not include important BGs
  1f_3f ae_vxy becomes major BG (Large cross section)
  My apology for miss estimation of that

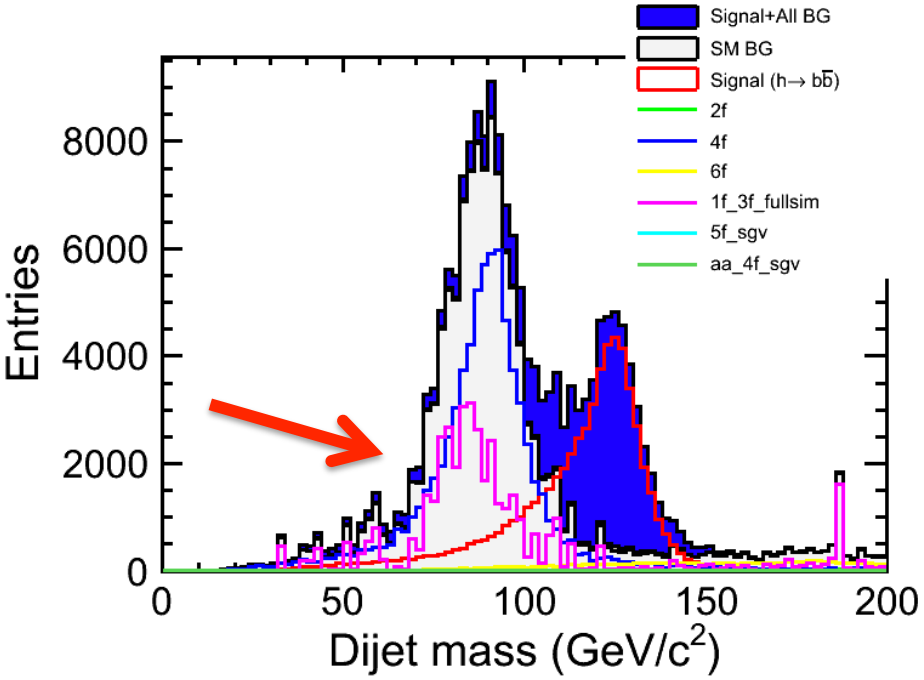
1f_3f, 5f, aa_4f SGV(fastsim) samples
1f_3f ae_vxy full sim sample (10k)
1f_3f ae_vxy SGV (5fb-1→100 fb-1) thanks Mikael
Higgs, 2f, 4f, 6f used fullsim samples

Dijet mass distribution

After all cuts Before b-tagging



After b-tagging



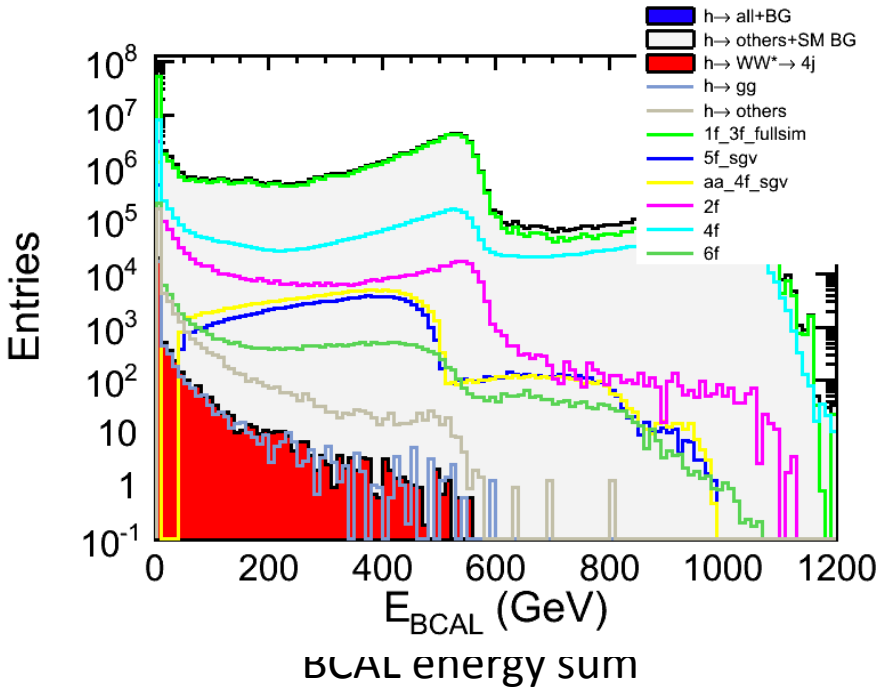
1f_3f ae_vxy contribution without B-tagging is large

→ B-tagging well work to suppress BGs

→ But other channel case especially h→WW* is problem

Additional cuts for ae, aa BGs

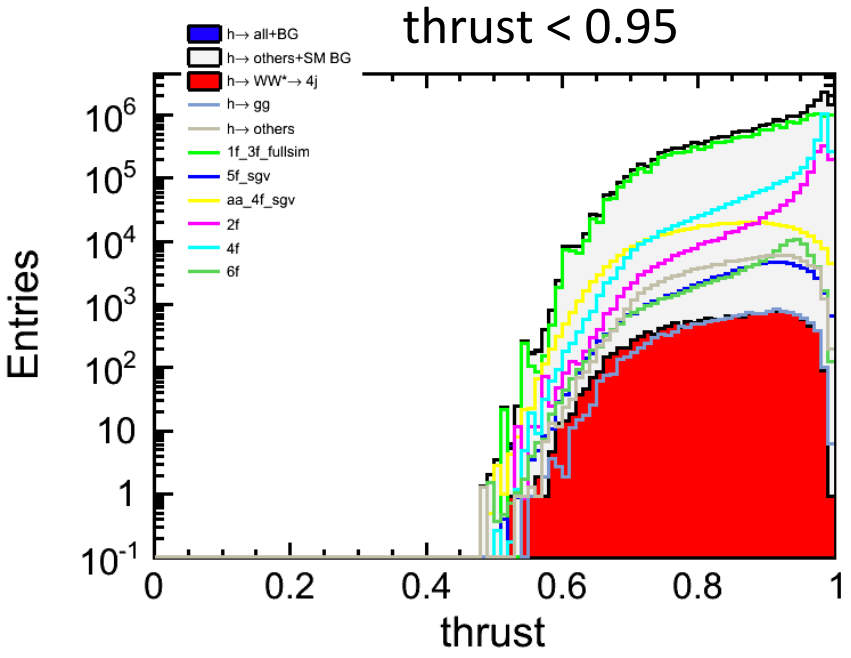
Very forward electron and photons are tagged by BCAL



BCAL energy sum

Remove events with BCAL Hit

E_{BCAL}<50 GeV



Remove ae, aa BGs

Thank you for Jenny and Mikael for this instruction

h→bb, cc, gg analysis

1f_3f ae_vxy background mainly contribute for h→cc, gg than vvZ
→B-tagging can suppress 3f backgrounds very efficiently

Previous cut

1. 45< Evis< 400 GeV
2. Pt > 20 GeV
3. Npfo>20
4. $|\cos\theta_h|<0.98$
5. 105<Mh<150 GeV

New cut

1. BCAL energy < 50 GeV
2. thrust <0.95
3. 100< Evis< 400 GeV
4. 40 < Pt
5. 40<Npfos
6. 110<Mh<150 GeV

7. h-blikeness>0.6← Simple cut case

Many thanks to
Mikael and Jenny
for many suggestions!

Results is strongly related Pt and Evis cut, SiD use tight cut and results are degraded. but reason is this BG. Results are coming today

h→WW* cut flow update

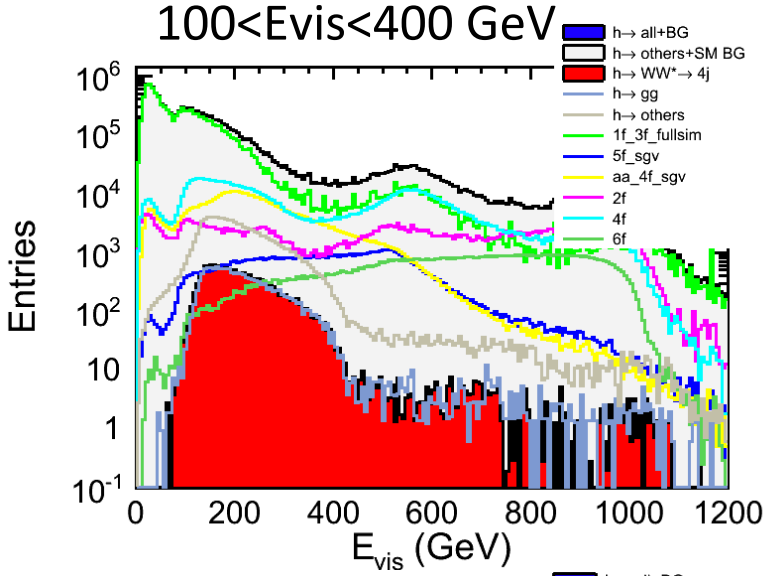
1. E_{BCAL}<50 GeV
2. thrust < 0.95
3. 150<Evis<400 GeV
4. Pt>40 GeV
5. Npfos<50
6. |cosθjet|<0.9
7. (Btag1+Btag2)<0.8
8. -Log10(Y34)<3.0
9. -Log10(Y23)<2.2
10. 65<M_{W1}<95 GeV
11. 15<M_{W2}<60 GeV
12. 110<M_h<150 GeV

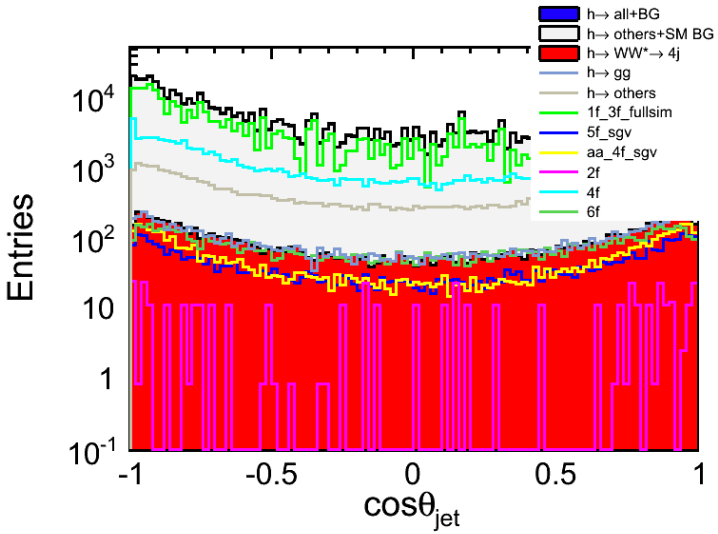
These cuts are newly included to treat aa_4f or ae_3f

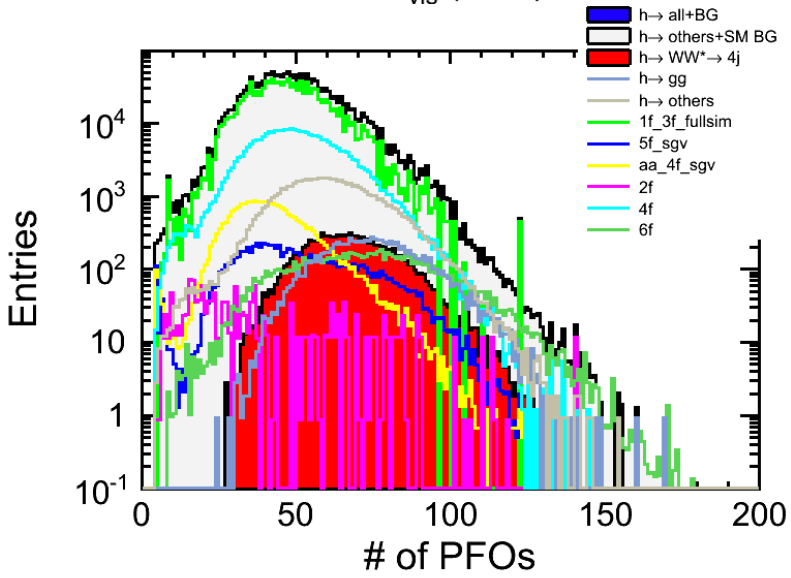
Change to be tighter for ae 3f treatment

Others are small optimization or not changed

Other cuts


100<Evis<400 GeV
Entries
E_{vis} (GeV)
h→ all+BG
h→ others+SM BG
h→ WW*→ 4j
h→ gg
h→ others
1f_3f_fullsim
5f_sgv
aa_4f_sgv
2f
4f
6f


Entries
$\cos\theta_{jet}$
h→ all+BG
h→ others+SM BG
h→ WW*→ 4j
h→ gg
h→ others
1f_3f_fullsim
5f_sgv
aa_4f_sgv
2f
4f
6f


Entries
# of PFOs
h→ all+BG
h→ others+SM BG
h→ WW*→ 4j
h→ gg
h→ others
1f_3f_fullsim
5f_sgv
aa_4f_sgv
2f
4f
6f

Preliminary results

h→WW* cut summary

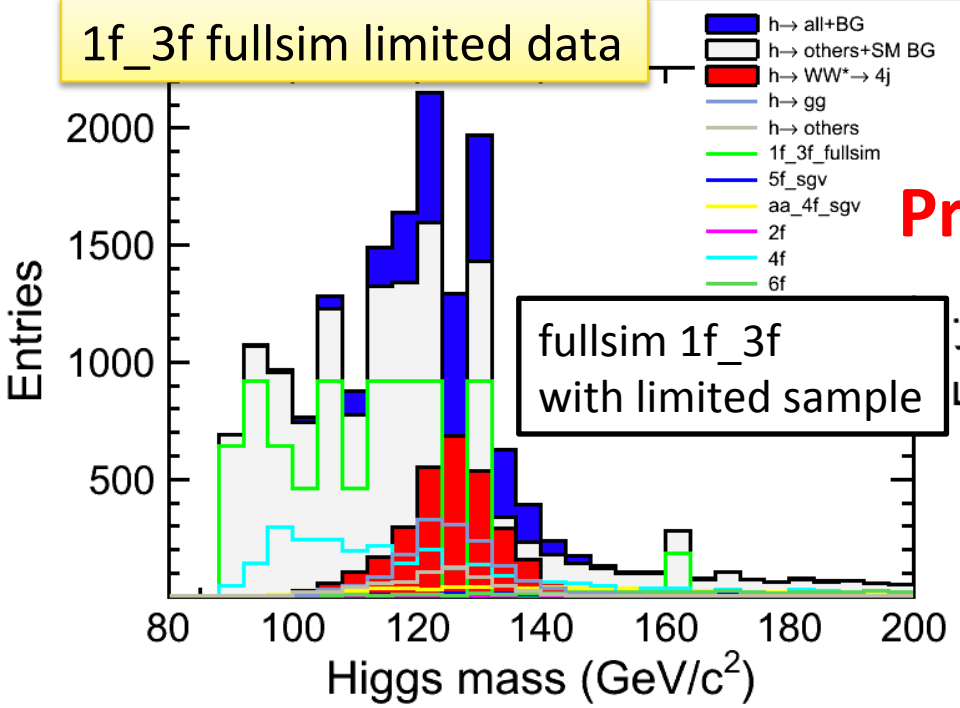
1f_3f, 5f, aa_4f use SGV fast sim data

	h->WW hadronic	h->bb	h->cc	h->gg	h->ZZ	1f_3f fullsim	1f_3f_sgv	5f_sgv	aa_4f_sgv	2f	4f	6f
No cut	21,976	128,700	6,058	19,045	5,979	131,829,000	223,685,000	615,361	1,538,560	3,890,180	13,514,000	346,419
1	21,348	124,986	5,873	18,514	5,797	58,417,500	72,758,000	483,560	1,284,930	3,347,830	8,442,530	317,394
2	19,256	109,860	5,188	16,530	5,006	21,233,700	23,638,800	408,482	1,102,330	771,237	2,929,920	260,408
3	14,534	82,950	4,108	12,709	2,924	4,580,980	4,982,480	105,205	606,486	133,143	803,488	30,640
4	12,934	72,718	3,611	11,310	2,540	1,795,870	3,099,840	48,574	134,493	9,045	589,653	24,604
5	11,200	52,786	2,201	10,589	1,718	530,494	356,221	9,210	16,274	618	182,539	16,206
6	6,243	26,440	1,106	5,902	922	164,694	187,036	4,145	7,973	202	67,130	9,328
7	5,919	963	991	5,499	607	155,831	183,886	3,949	7,808	97	49,282	4,862
8	5,107	361	358	3,161	501	65,429	100,758	3,578	6,841	48	19,711	4,084
9	4,459	254	248	2,191	415	38,228	59,389	3,399	6,405	48	12,140	3,904
10	3,718	190	198	1,818	331	11,861	10,760	3,017	5,060	48	6,483	3,592
11	3,528	166	170	1,652	304	10,299	7,140	956	3,237	23	4,411	961
12	3,180	139	144	1,464	266	5,237	3,450	178	1,019	12	1,537	147
Eff	14.5%	0.1%	2.4%	7.7%	4.5%	4.E−05	2.E-05	3.E-04	7.E-04	3.E-06	1.E-04	4.E-04

Reconstructed Higgs mass

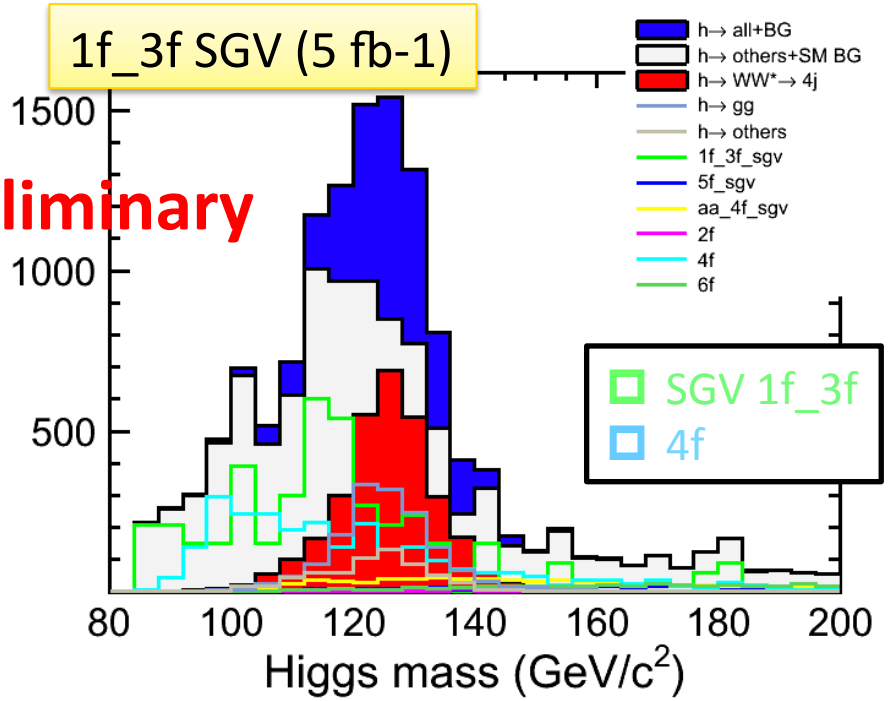
Note: 5f, aa_4f backgrounds are SGV fast simulation data

1f_3f fullsim limited data



Preliminary

1f_3f SGV (5 fb-1)



1f_3f ae_vxy becomes main contribution to final state instead of 4f
SGV also still small statistics. Now Mikael increase this SGV sample

Previous signal significance = 46
Current signal significance with SGV~30

Preliminary results
σBR(h→WW*→4j)~3% (SGV)

Summary of ILD and SiD

To be completed

	ILD			SiD		
Lumi	500 fb-1	500 fb-1	1 ab-1	500 fb-1	500 fb-1	1 ab-1
Pol	(-0.8, +0.2)	(+0.8, -0.2)	(-0.8, +0.2)	(-0.8,+0.2)	(+0.8, -0.2)	(-0.8, +0.2)
h→bb				0.65%	2.6%	0.46%
h→cc				0.89%	56.9%	6.3%
h→gg				4.0%	23.4%	2.8%
h→WW*	3%			4.2%	26%	3.0%

According to the SiD Homer Neal ‘s summary table