Study of the Higgs Self-coupling at the ILC

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analysis with cheated jet clustering (vvHH)

strategy

pre-selection:

- same strategy as real analysis
- cheat jet clustering algorithm
- jets are paired using color singlet information
- use the real LCFIVertex for flavor tagging

final selection:

- same strategy as previous analysis
- all the input variables of neural-net are the same
- slightly adjusted final cuts

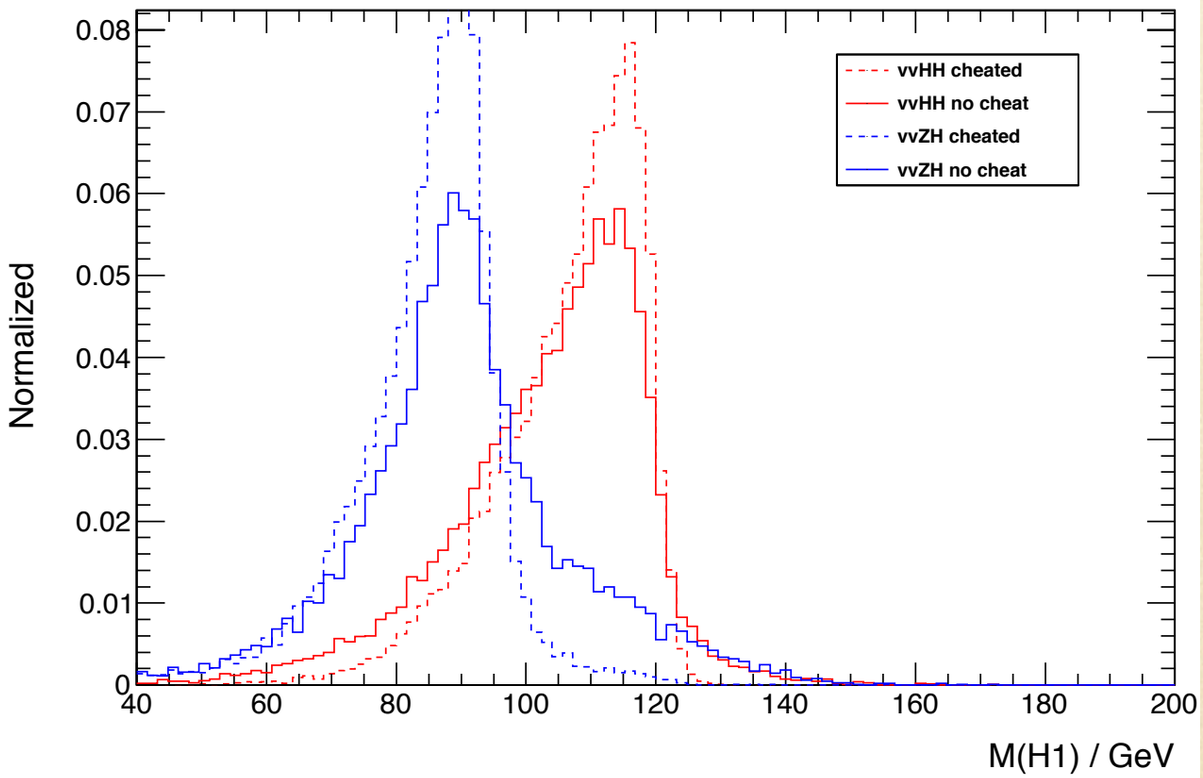
dominant backgrounds: bbbb, lvbbqq, vvbbbb, vvbbH

performances of the cheated jet clustering algorithm

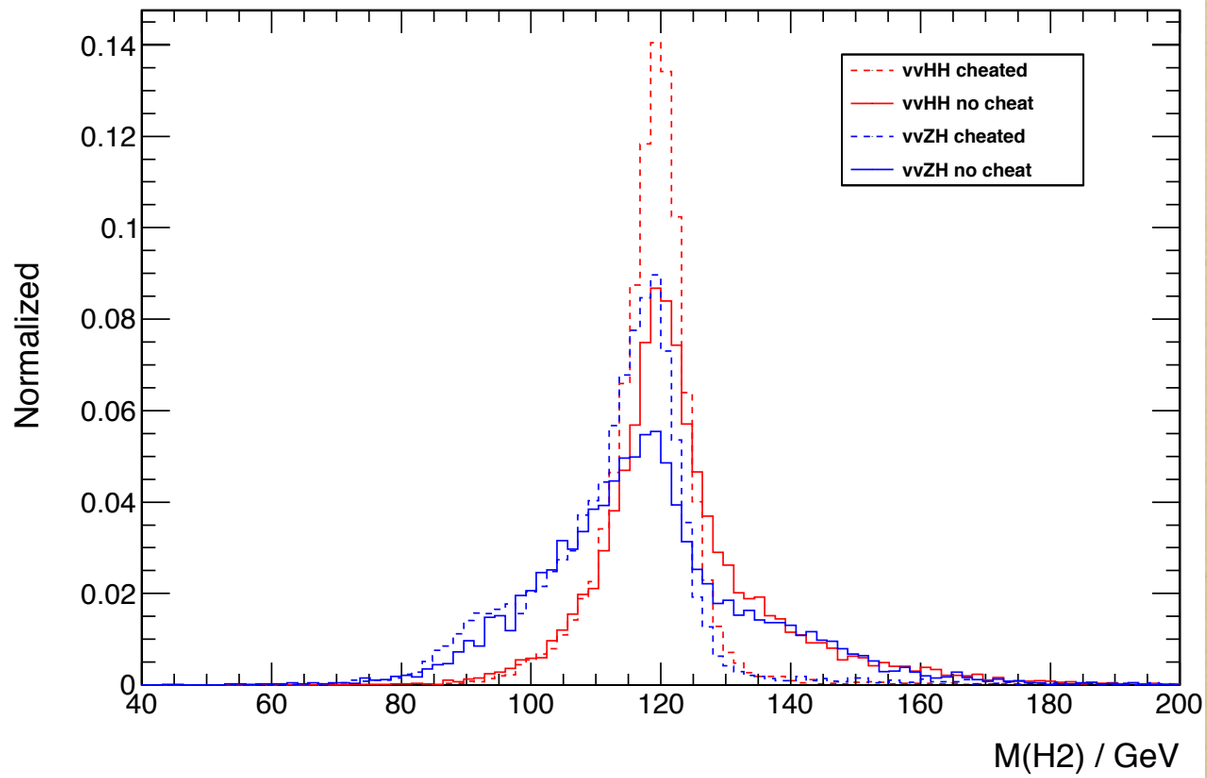
Higgs mass

vvHH mode: (ZZH)

smaller one

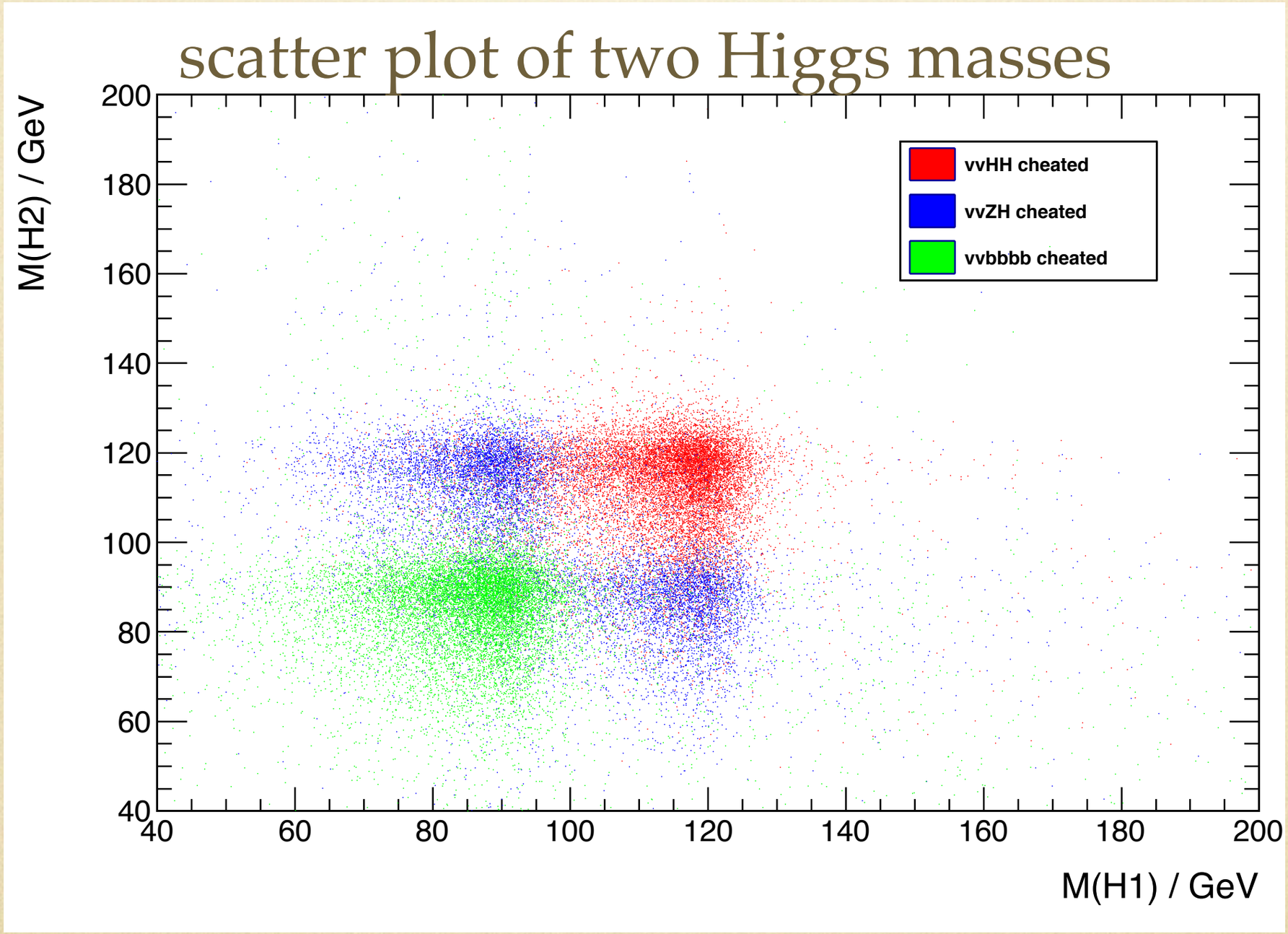


larger one



comparison with dominant backgrounds

all with the cheated jet clustering vvHH mode: (ZZH and ZZZ)

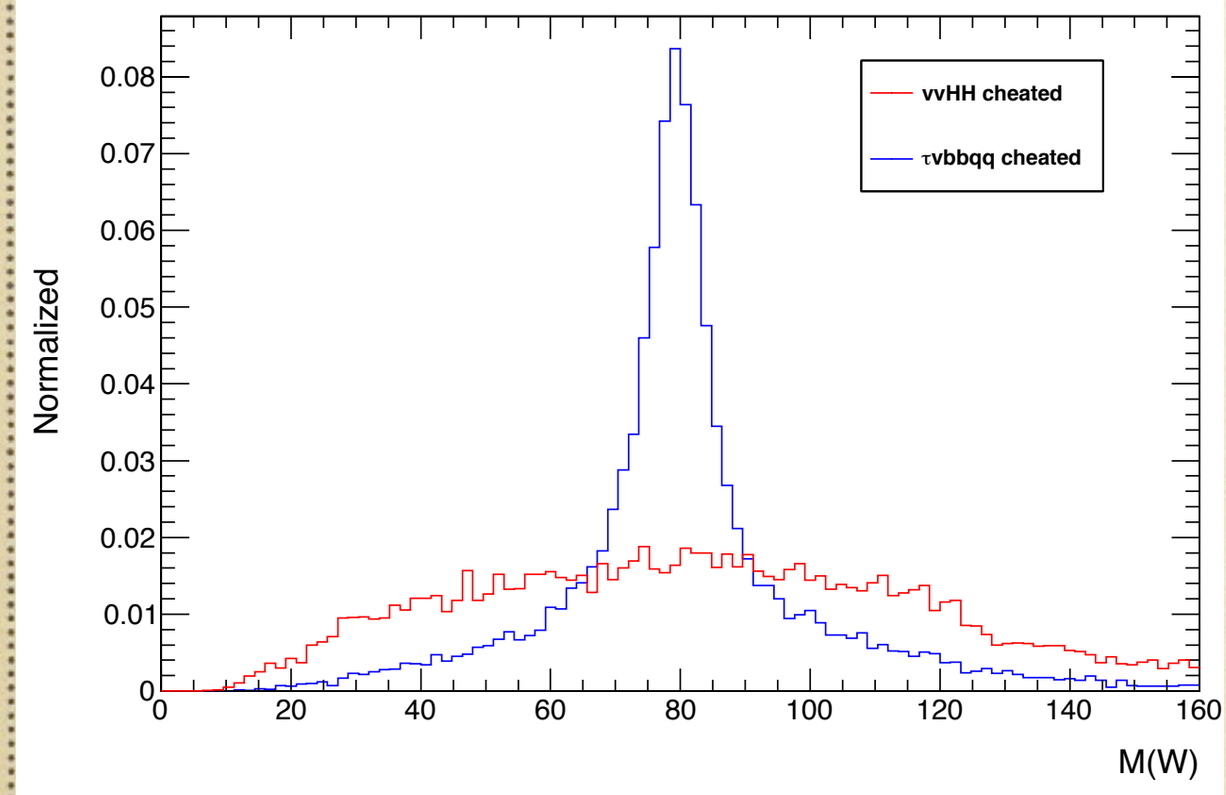


performances of the cheated jet clustering algorithm

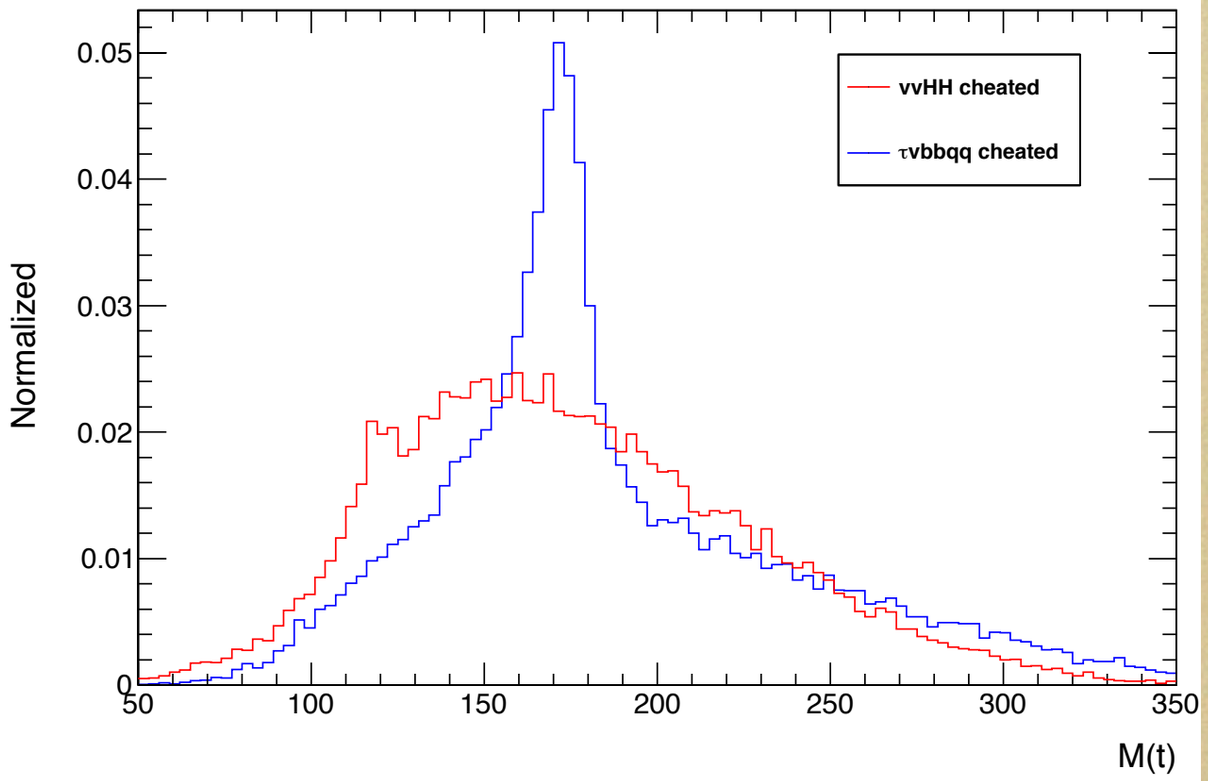
W and top mass

vvHH mode: (τνbbqq)

Invariant mass of W



Invariant mass of top quark

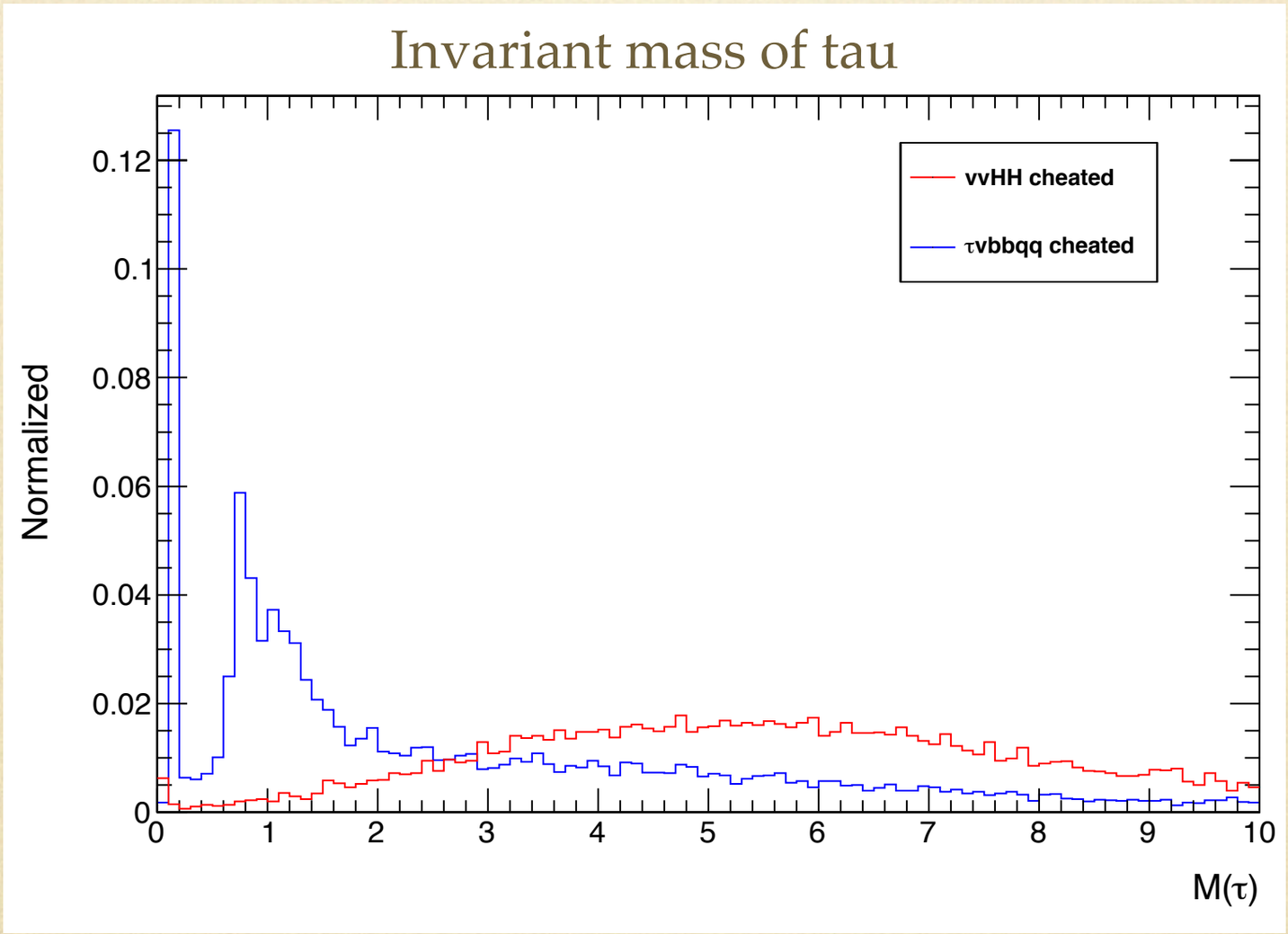


(two combinations superposed)

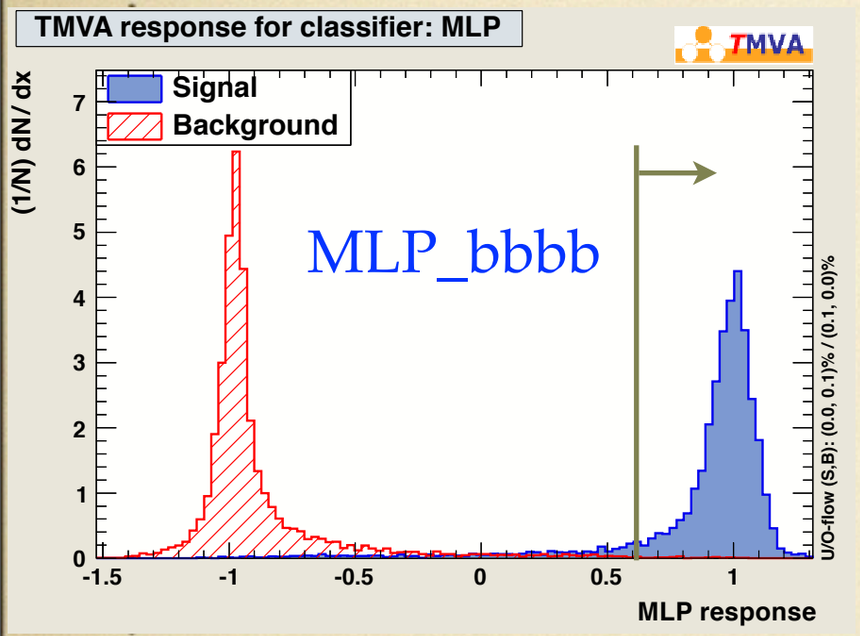
performances of the cheated jet clustering algorithm

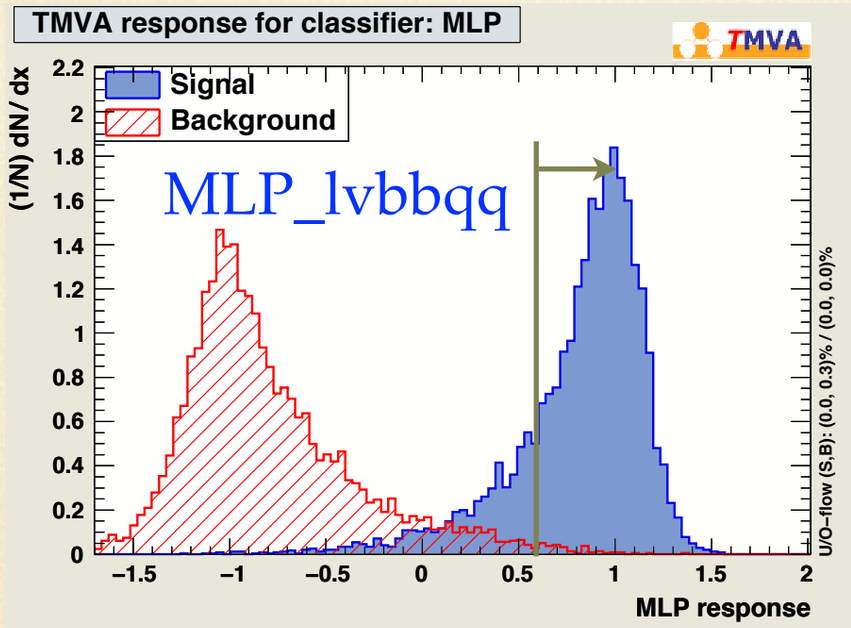
tau jet mass

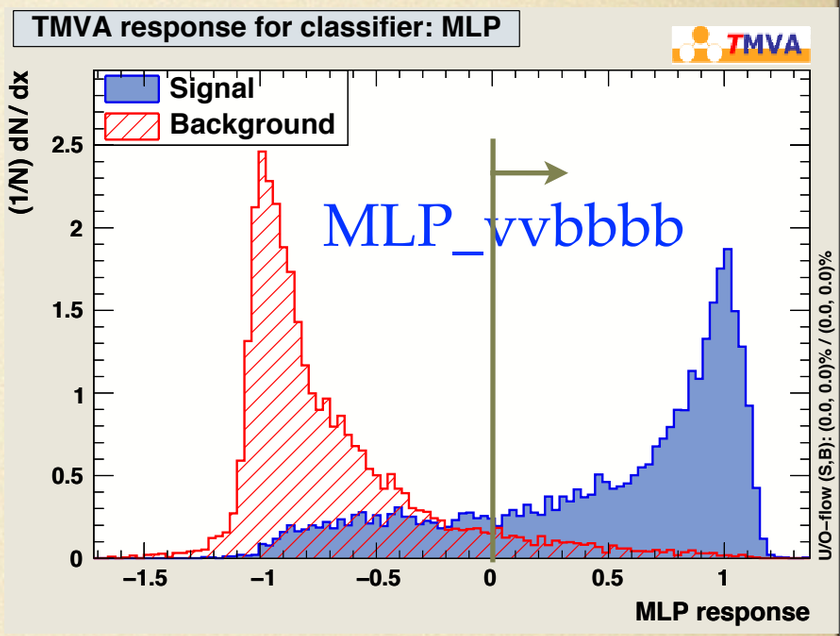
vvHH mode: (τνbbqq)



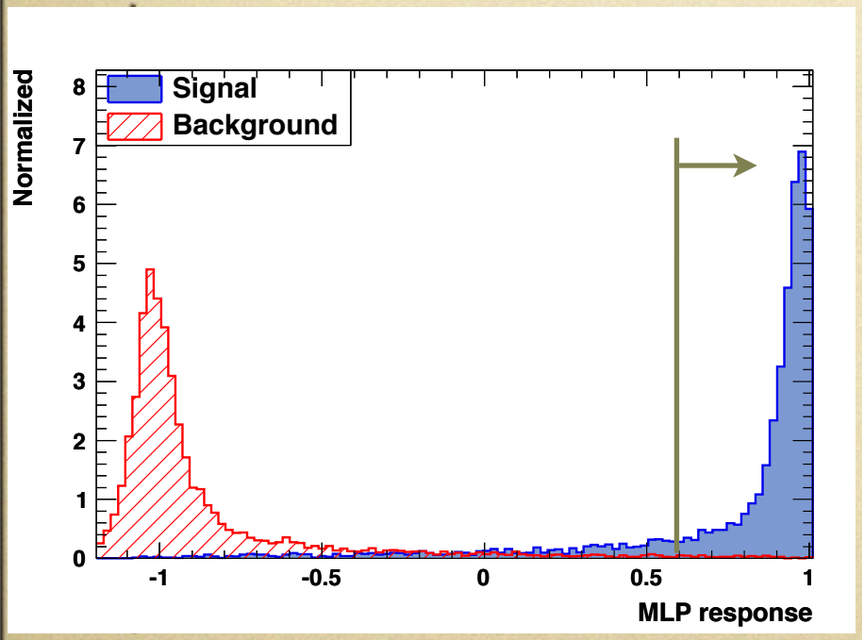
performance of the neural-net (cheated)

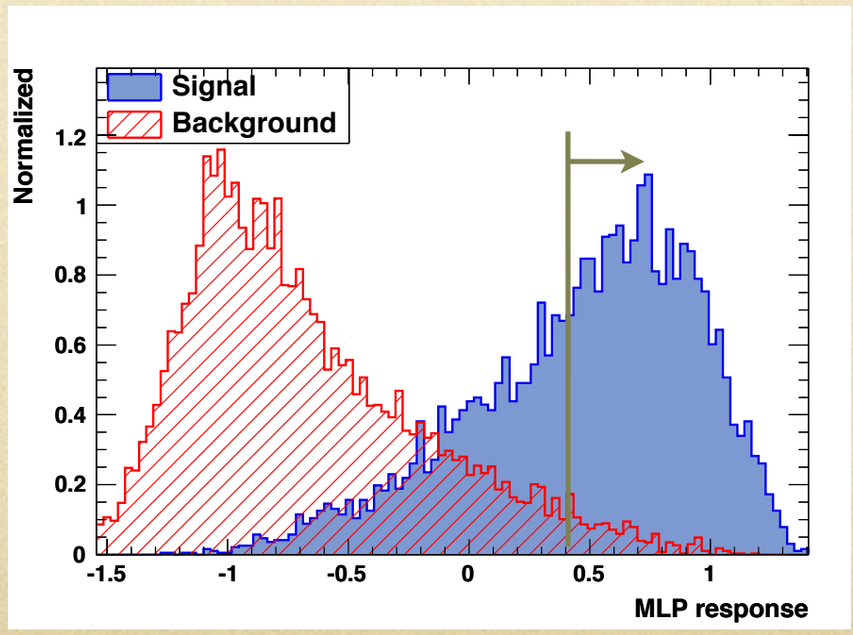


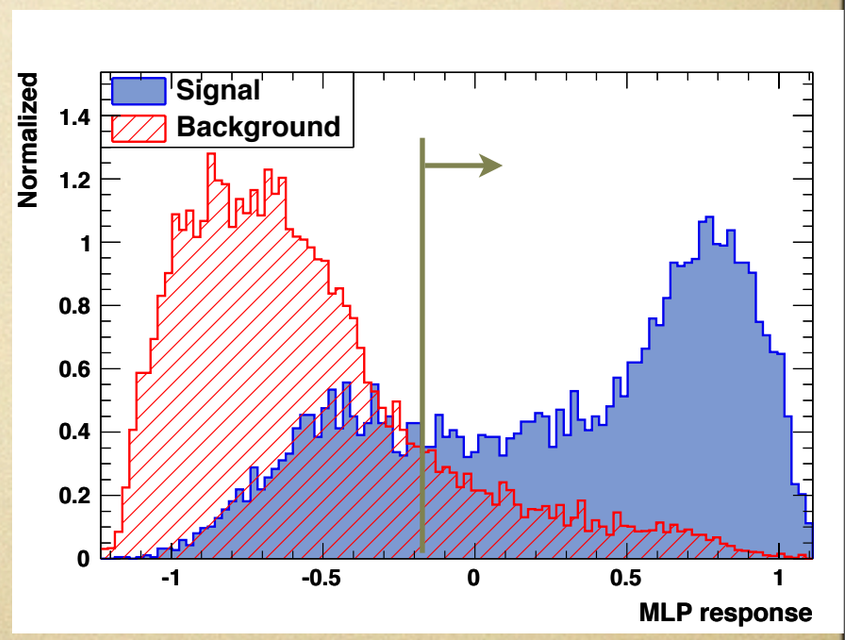




real







preliminary reduction table (ννHH) cheated

Polarization: (e-,e+)=(-0.8,+0.3) $E_{\rm cm} = 500{\rm GeV}, M_H = 120{\rm GeV}$ $\int Ldt = 2{\rm ab}^{-1}$

normalized	expected	MC	pre-selection	Evis-0.83MissPt <350 MissMass > 0	NpfosMin>=8 Ycut>0.002 mhh>200	MLP_bbbb>0.6	MLP_lvbbqq>0.6	MLP_vvbbbb>0.	Bmax3+Bmax4 >1.15
ννhh(ννbbbb)	109.9(49.0)	45000	39.1(36.7)	37.4(35.0)	34.3(33.0)	30.3(29.2)	24.3(23.4)	20.8(20.0)	8.29(8.23)
BG			39411	21125	13723	7292	124	88.4	~2.03
ννbbbb	105	30000	73.9	72.4	51.3	26.7	4.93	0.39	0.15
ννbbH	92.7	23670	47.0	45.7	41.6	30.7	8.53	2.29	0.98
bbbb	40824	414165	10343	977	810	6.20	0.77	0.34	0
eνbbqq	273733	242851	2156	1370	1080	665	10.3	8.60	0
μνbbqq	273733	241777	2208	1630	1391	858	10.3	6.86	0
τνbbqq	273733	159174	24583	17030	10349	5705	89.0	69.9	~1.00

(same test samples used for τνbbqq)

signal: 8.3 (5.2)
backgrounds: 2.0 (7.0)
significance: 4.0σ (1.7σ)

backup

reduction table (vvHH)

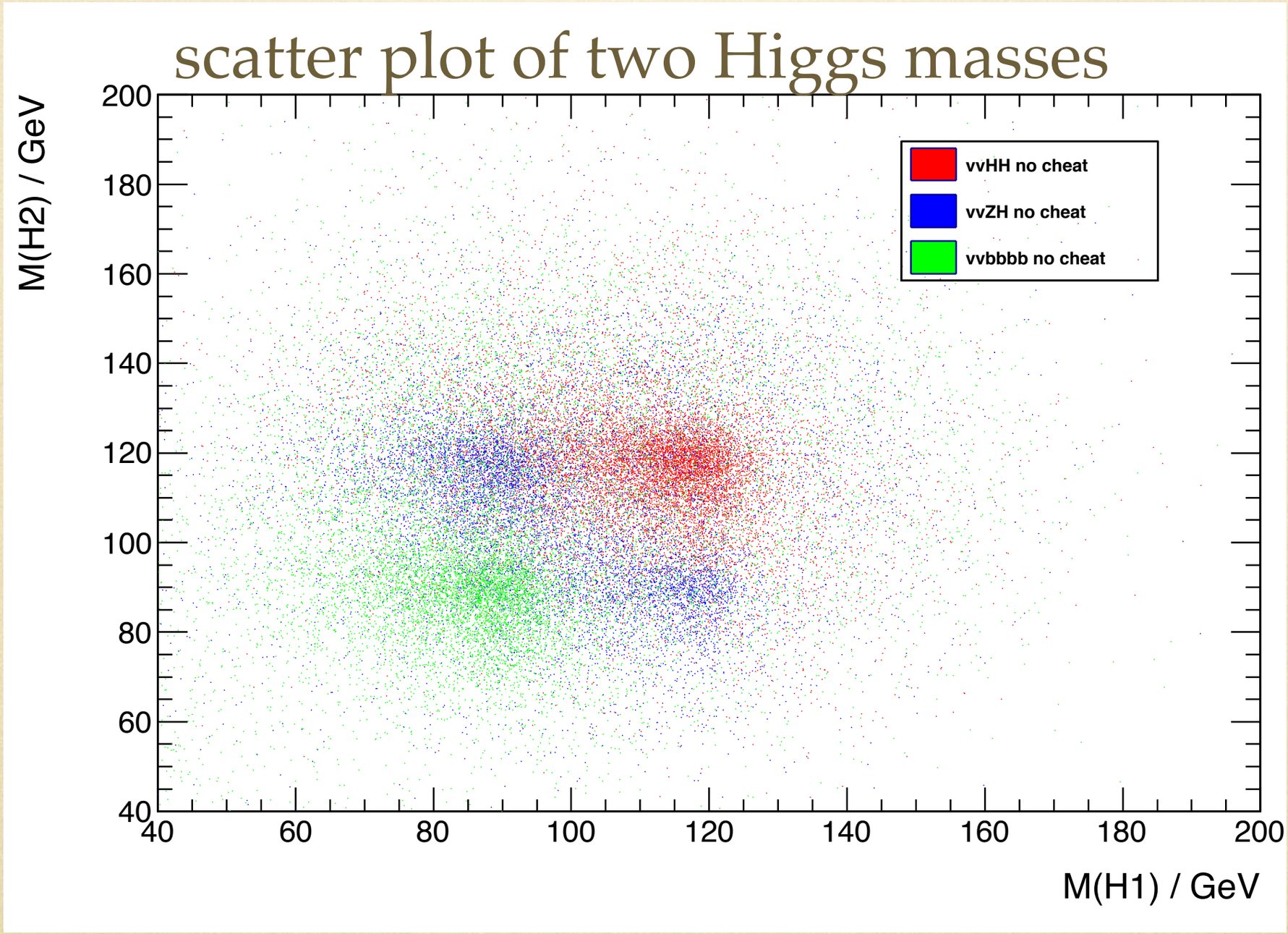
real

Polarization: (e-,e+)=(-0.8,+0.3) $E_{\rm cm} = 500{\rm GeV}, M_H = 120{\rm GeV}$ $\int Ldt = 2{\rm ab}^{-1}$

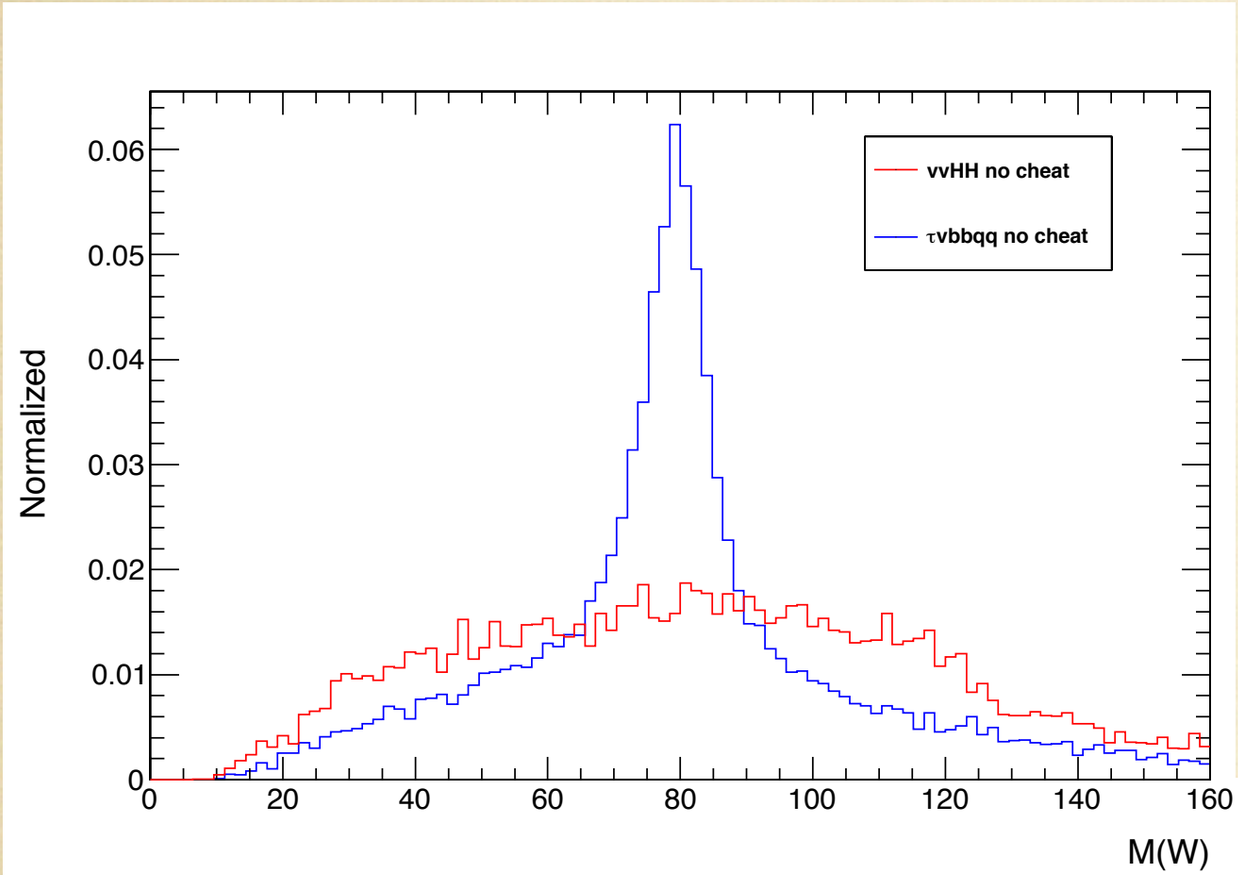
normalized	expected	MC	pre-selection	Evis-0.83MissPt <350 MissMass > 0	NpfosMin>=8 Ycut>0.002 mhh>200	MLP_bbbb>0.6	MLP_lvbbqq>0.42	MLP_vvbbbb>-0.18	Bmax3+Bmax4 >1.15
vvhh(vvbbbb)	109.9(49.0)	45000	36.7(34.7)	35.1(33.1)	31.0(29.9)	26.2(25.3)	15.6(15.3)	12.8(12.5)	5.21(5.20)
BG			122246	32598	16814	8886	444	323	7.00
vvbbbb	105	30000	69.7	68.2	46.6	27.1	8.50	2.25	0.63
vvbbH	92.7	23670	45.4	44.1	38.5	29.4	10.2	3.92	1.50
bbcsdu	394548	405727	18436	205	203	37.0	8.75	8.75	0
bbuddu	199165	231600	2616	32.7	31.0	4.30	0	0	0
bbcssc	197790	230721	17158	237	233	39.4	6.86	6.86	0
qqbb	312453	29637	21340	3108	1646	57.6	23.0	23.0	0
bbbb	40824	414165	23785	2332	1801	24.7	7.73	5.07	1.62
llbb	335019	610502	3290	183	10.2	0.14	0	0	0
vvbb	311451	30001	8336	8139	62.3	41.5	0	0	0
evbbqq	273733	242851	2237	1425	1166	839	18.9	12.0	0
μvbbqq	273733	241777	2217	1662	1446	1041	32.6	25.7	0
τvbbqq	273733	1815503	22717	15160	10140	6745	327	235	3.25

comparison with dominant backgrounds

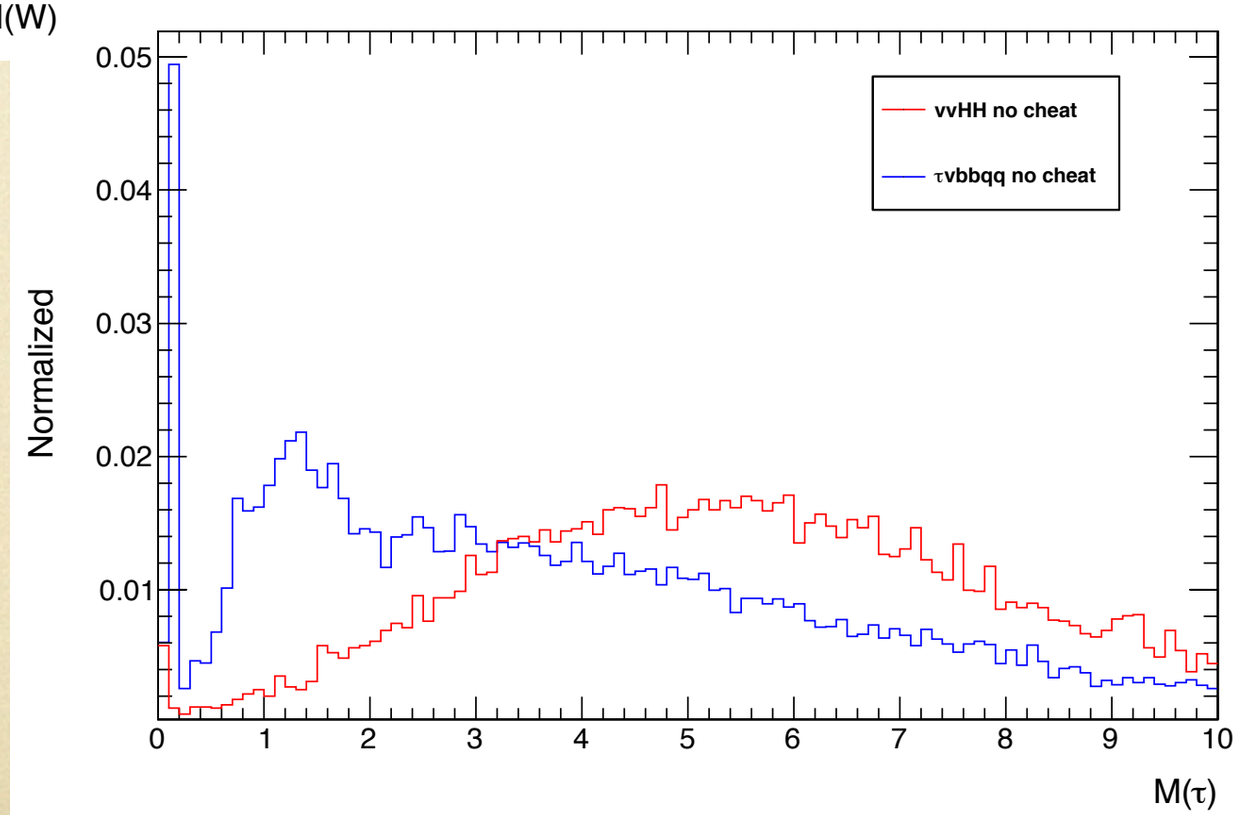
real case vvHH mode: (ZZH and ZZZ)



Invariant mass of W and tau (real case)



vvHH mode: (τνbbqq)



cheated jet clustering algorithm

three new processors are developed:

- ISRTaggerProcessor

  identify the initial-state-radiated photons

- ColorSingletTaggerProcessor

  find the originated color singlet for each PFO

  find the B-hadron for each PFO if it is decayed from

- SatoruJetFinderWithCheatProcessor

  combine the PFOs from a same color singlet

  combine the PFOs from a same B-hadron