

# Study of the Higgs Self-coupling at the ILC

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# analysis with cheated jet clustering ( $\nu\nu HH$ ) preliminary

Polarization:  $(e^-, e^+) = (-0.8, +0.3)$   $E_{cm} = 500\text{GeV}$ ,  $M_H = 120\text{GeV}$

$$\int L dt = 2\text{ab}^{-1}$$

normalized	expected	MC	pre-selection	$E_{vis} < 0.83 \text{MissPT} < 350$ $\text{MissMass} > 0$	$N_{\text{ptosMin}} \geq 8$ $Y_{\text{cut}} > 0.002$ $m_{hh} > 200$	$\text{MLP}_{\text{bbbb}} > 0.6$	$\text{MLP}_{\text{vbbbqq}} > 0.6$	$\text{MLP}_{\text{vbbbb}} > 0$	$B_{\text{max3}} + B_{\text{max4}} > 1.15$
$\tau\nu\text{bbqq}$	273733	159174	24583	17030	10349	5705	89.0	69.9	$\sim 1.00$
$\tau\nu\text{bbqq}$	273733	1815530	25890	16952	9813	5404	113	88.2	1.45

with the same samples as in previous real analysis

signal: 8.3 (5.2)  
backgrounds: 2.6 (7.0)  
significance:  $3.6\sigma$  ( $1.7\sigma$ )

cheated

Modes	signal	background	excess significance
$ZHH \rightarrow (l\bar{l})(b\bar{b})(b\bar{b})$	7.3	1.4	$3.9\sigma$
$ZHH \rightarrow (\nu\bar{\nu})(b\bar{b})(b\bar{b})$	8.3	2.6	$3.6\sigma$
$ZHH \rightarrow (q\bar{q})(b\bar{b})(b\bar{b})$	on going		

backup

preliminary

# reduction table ( $\nu\nu HH$ )

cheated

Polarization:  $(e^-, e^+) = (-0.8, +0.3)$   $E_{cm} = 500\text{GeV}$ ,  $M_H = 120\text{GeV}$

$$\int L dt = 2\text{ab}^{-1}$$

normalized	expected	MC	pre-selection	$E_{vis} < 0.83 \text{MissPt} < 350$ $\text{MissMass} > 0$	$N_{\text{posMin}} \geq 8$ $Y_{cut} > 0.002$ $m_{hh} > 200$	$\text{MLP}_{\text{bbbb}} > 0.6$	$\text{MLP}_{\nu\text{bbqq}} > 0.6$	$\text{MLP}_{\nu\text{bbbb}} > 0$	$B_{\text{max3}} + B_{\text{max4}} > 1.15$
$\nu\nu hh(\nu\nu bbbb)$	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	$\sim 2.03$
$\nu\nu bbbb$	105	30000	73.9	72.4	51.3	26.7	4.93	0.39	0.15
$\nu\nu bbH$	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
$e\nu\text{bbqq}$	273733	242851	2156	1370	1080	665	10.3	8.60	0
$\mu\nu\text{bbqq}$	273733	241777	2208	1630	1391	858	10.3	6.86	0
$\tau\nu\text{bbqq}$	273733	159174	24583	17030	10349	5705	89.0	69.9	$\sim 1.00$

(same test samples used for  $\tau\nu\text{bbqq}$ )

signal: 8.3 (5.2)

backgrounds: 2.0 (7.0)

significance:  $4.0\sigma$  ( $1.7\sigma$ )

# reduction table (vvHH)

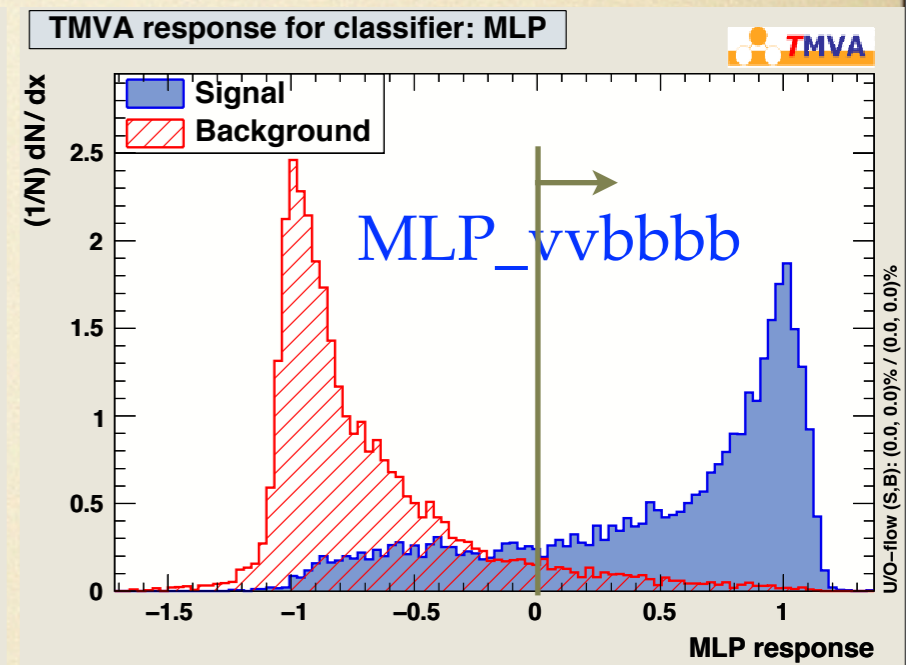
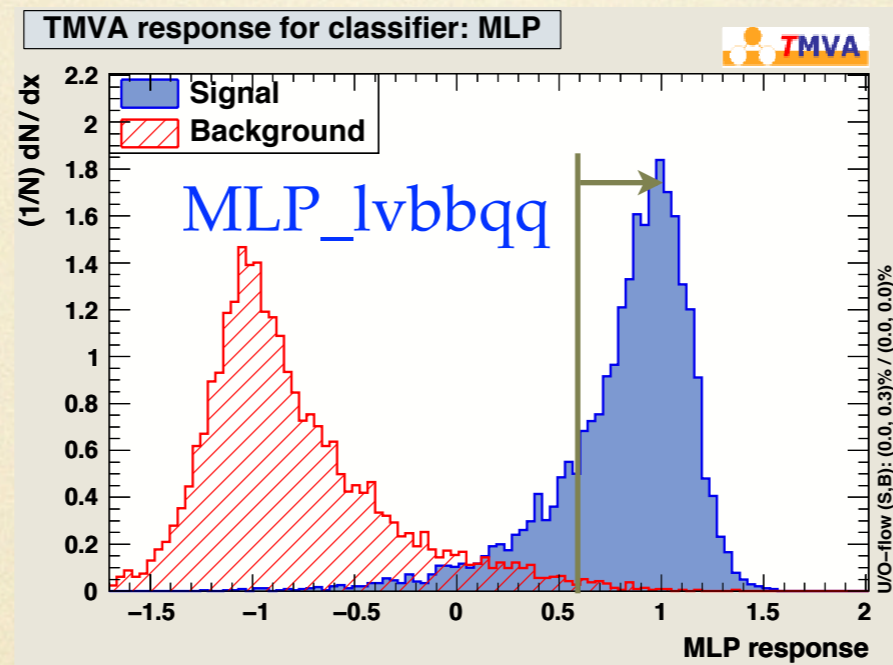
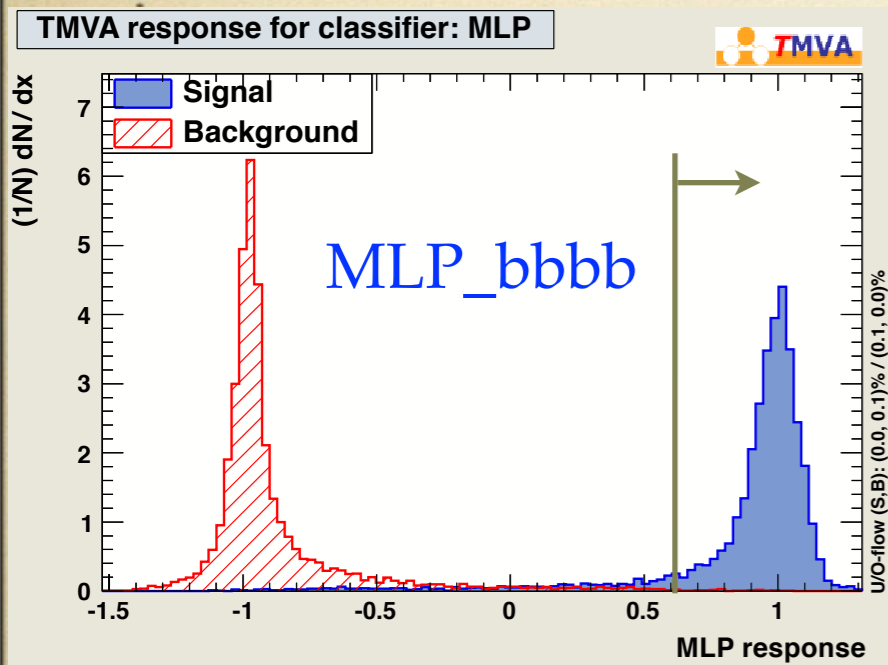
real

Polarization:  $(e^-, e^+) = (-0.8, +0.3)$   $E_{cm} = 500\text{GeV}$ ,  $M_H = 120\text{GeV}$

$$\int L dt = 2\text{ab}^{-1}$$

normalized	expected	MC	pre-selection	$E_{vis} > 0.83 M_{vis} PT < 350$ $MissMass > 0$	$N_{pfos} Min > 8$ $Y_{cut} > 0.002$ $m_{hh} > 200$	$MLP_{bbbb} > 0.6$	$MLP_{lvbbqq} > 0.42$	$MLP_{vvbbbb} > 0.18$	$B_{max3} - B_{max4} > 1.15$
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
$\mu$ vbbqq	273733	241777	2217	1662	1446	1041	32.6	25.7	0
$\tau$ vbbqq	273733	1815503	22717	15160	10140	6745	327	235	3.25

# performance of the neural-net (cheated)



real

