THE PRODUCTION OF A HEAVY SCALAR H IN ASSOCIATION WITH TOP AND ANTI-TOP QUARKS

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Top associated Higgs production

- Small H > VV branching fraction, enhanced p > tH cross section
- Other production mechanisms are Vector Boson Fusion (VBF) and g g > H

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Process

- The process of interest is that of

  p p > t t~ h

  p p > (t + t~)h + jets

- The top quarks are heavy particles per SM
- This implies their decay before hadronization (forming of jets)

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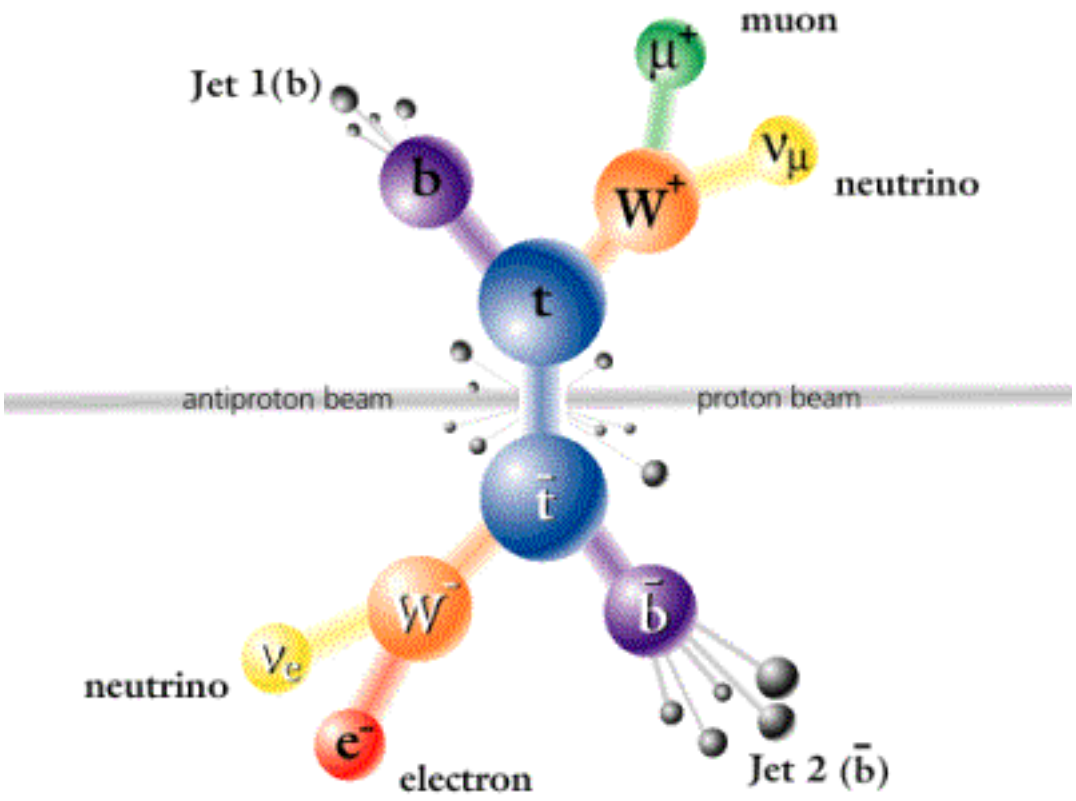
Possible decay schemes for the top quark

- The decay of the top quark



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The Standard Model (SM) Higgs picture

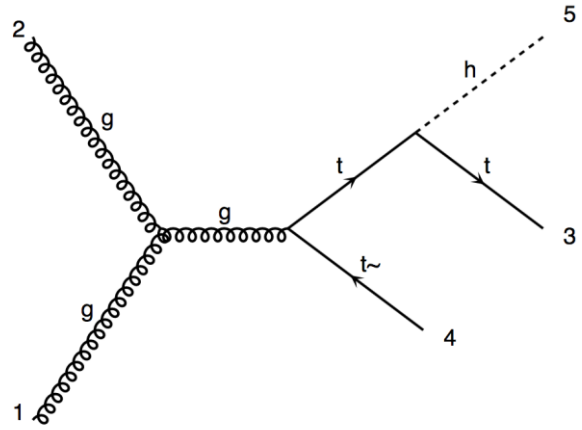

diagram 1 QCD=2, QED=1

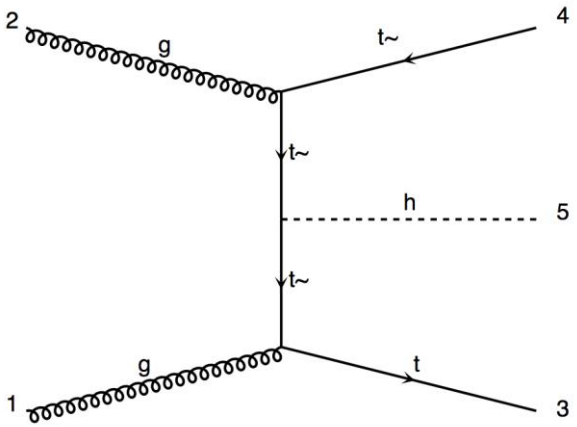

diagram 3 QCD=2, QED=1

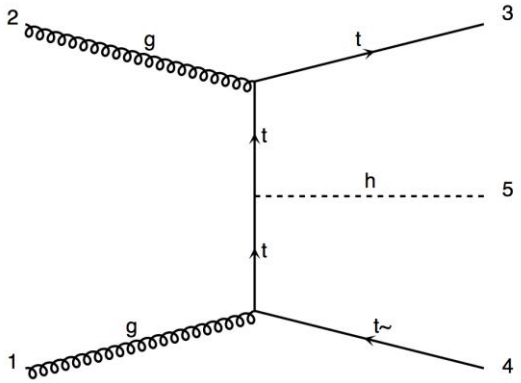

diagram 5 QCD=2, QED=1

Diagrams 1, 3 and 5 are MadGraph generated Feynman diagrams for the two-quark (4FS) higgs production

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The Standard Model (SM) Higgs picture

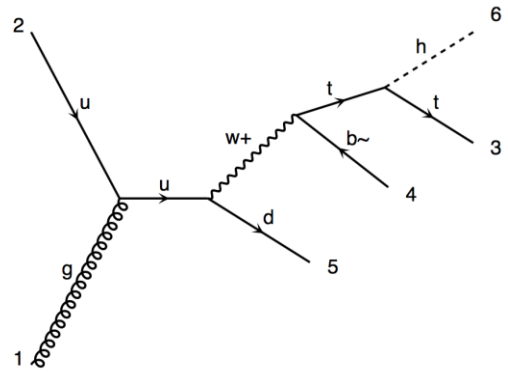

diagram 2 QCD=1, QED=3

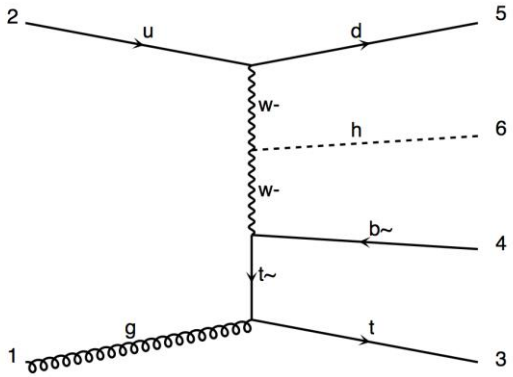

diagram 4 QCD=1, QED=3

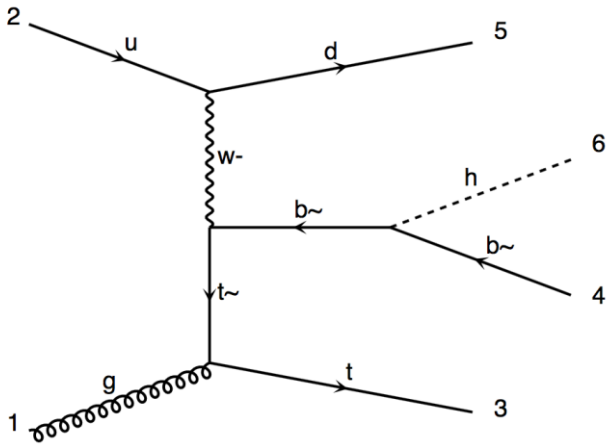

diagram 6 QCD=1, QED=3

Diagrams 2, 4 and 6 are MadGraph generated Feynman diagrams for the one-quark (5FS) higgs production

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MadGraph Generated Cross Sections

Two Quark SM Higgs Production		
COM Energy (GeV)	Mass (TeV)	Cross section (pb)
8	125	0.1092 ± 0.00014
	270	0.009557 ± 1.4e-05
13	125	0.3991 ± 0.00054
One Quark SM Higgs Production		
COM Energy (GeV)	Mass (TeV)	Cross section (pb)
8	125	0.1091 ± 0.00026
	270	0.009536 ± 1.5e-05
13	125	0.3982 ± 0.00086
	270	0.0432 ± 0.00018

Introducing The Heavy scalar boson H

- The process of interest is the collision of

  p p > t t~ H

  p p > (t + t~)H + jets

- The Heavy scalar decays by H > h X X

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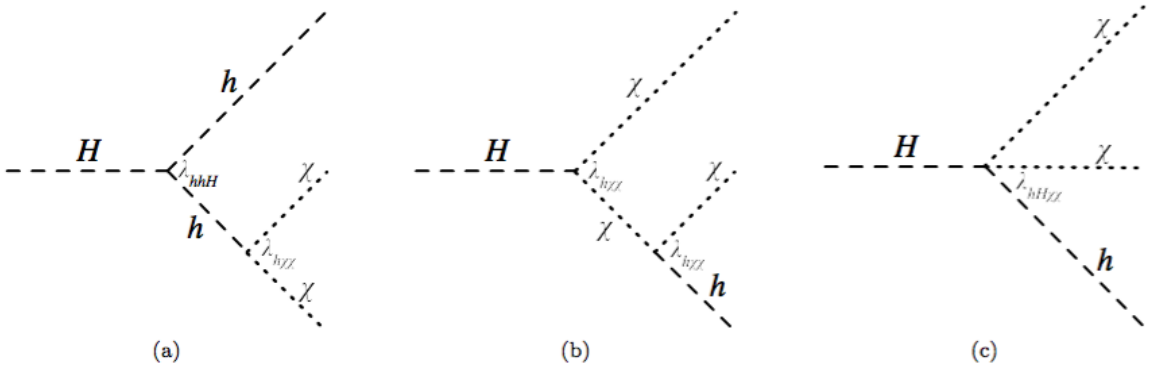
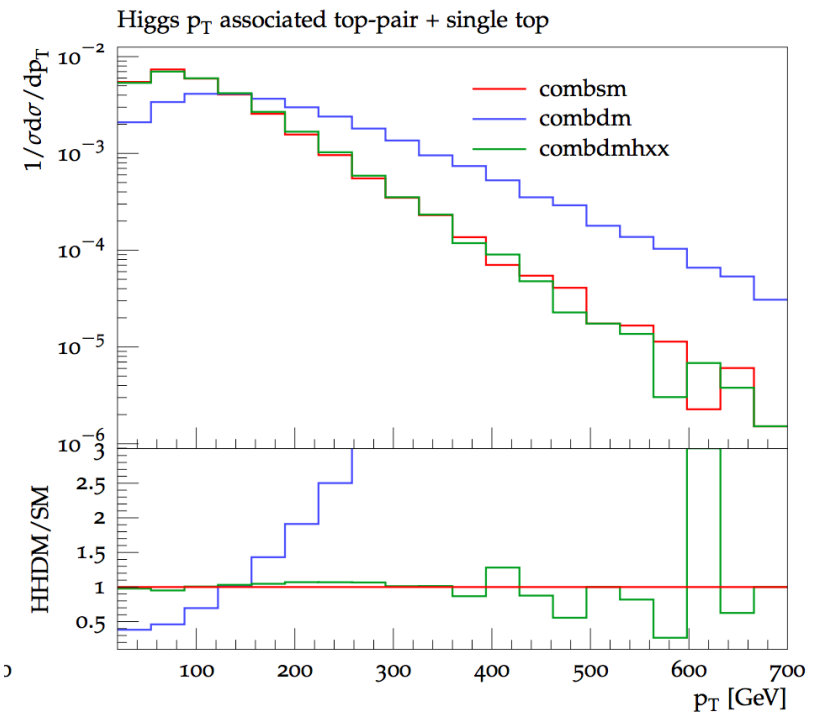
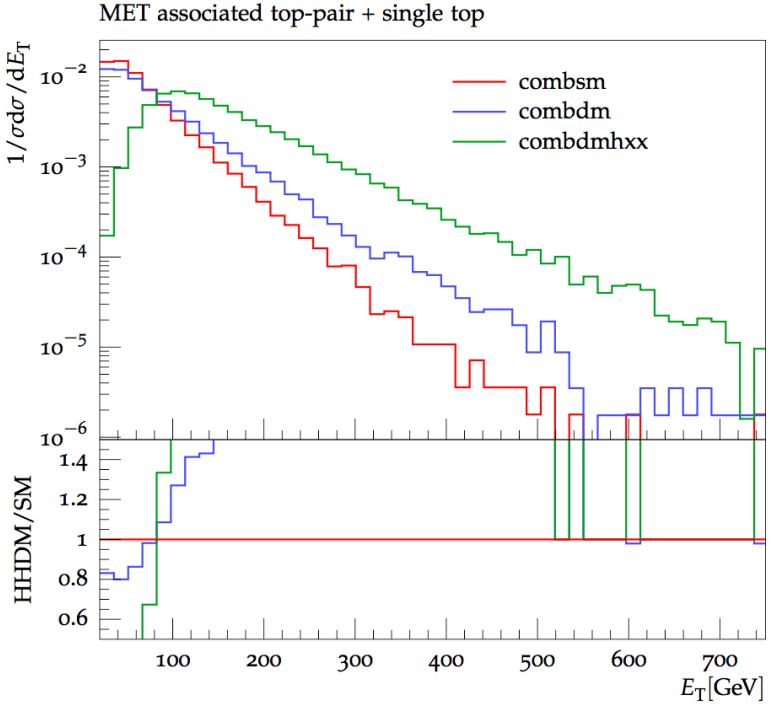
Feynman Diagrams of H decay



Some subsequent work on top associated Higgs production





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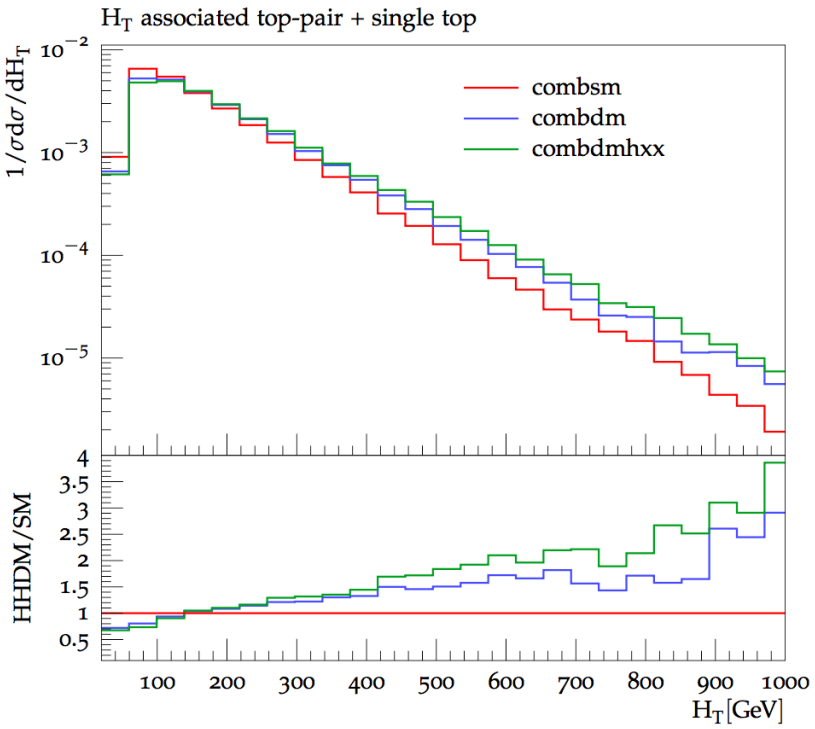
H_T associated top-pair + single top
$1/\sigma d\sigma/dH_T$
combsm
combdm
combdmhxx
HHDM/SM
H_T[GeV]

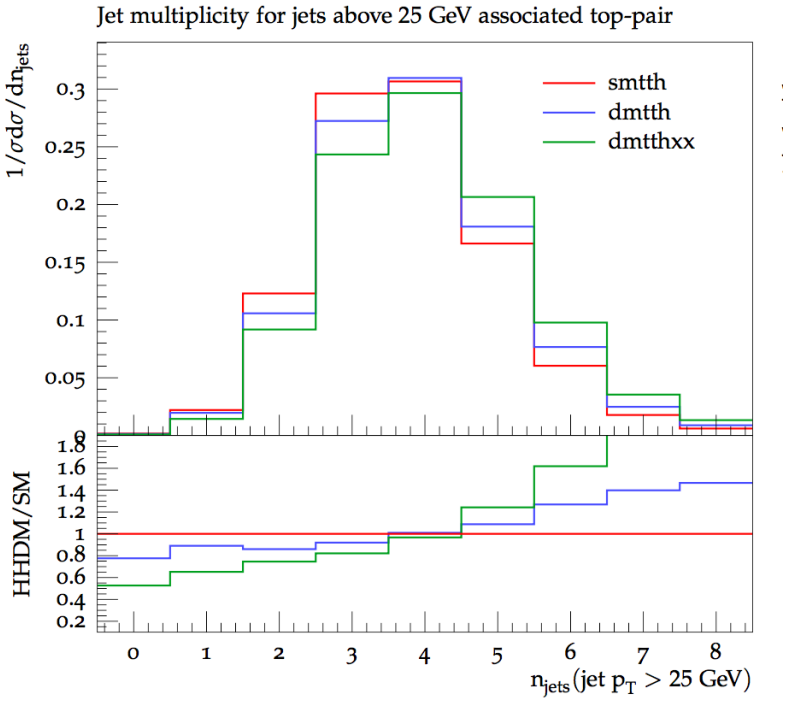
Jet multiplicity for jets above 25 GeV associated top-pair
$1/\sigma d\sigma/dn_{jets}$
smtth
dmtth
dmtthxx
HHDM/SM
n_{jets}(jet p_T > 25 GeV)

Table 1

Cut-flows all	$t\bar{t}h$	$t\bar{t}H$, $H \to h\chi\chi$	$thj + \bar{t}hj$	$tHj + \bar{t}Hj$, $H \to h\chi\chi$	$t\bar{t}h + thj + \bar{t}hj$	$t\bar{t}H + tHj + \bar{t}Hj$, $H \to h\chi\chi$
Total events	30000	30000	30000	30000	60000	60000
2 leptons with same sign	10933	11011	10023	10171	20956	21182
$\|\eta\| < 2.5$ for leptons	9614	9800	7360	7652	16974	17452
p_T cut: leading lepton > 25 GeV, sub-leading lepton > 15 GeV	2305	2622	1156	1326	3461	3948
Number of jets >= 2 (at least 2 jets)	2301	2622	1115	1295	3461	3917
exactly 1-bTagged events	573	661	632	753	1205	1414
>= 2 bTagged events	1682	1921	377	462	2059	2383
exactly 1-bTagged events:						
400 < HT < 700, MET > 40	189	291	116	265	305	556
HT >= 700, 40 < MET < 100	26	22	16	11	42	33
700 >= HT , MET >= 100	36	184	21	58	57	242
at least 2-bTagged events:						
400 < HT < 700, MET > 40	629	829	102	198	731	1027
HT >= 700, 40 < MET < 100	151	134	19	8	170	142
700 >= HT , MET >= 100	143	643	16	69	159	712
NJets $\in$[2,4], bTagged >= 1, $\Delta\phi_{ll} >$ 2.5, HT > 450, MET > 40	33	63	32	65	65	128

Questions

- I'm timing you

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