

Lifting degeneracies in Higgs couplings using single top production in association with a Higgs boson

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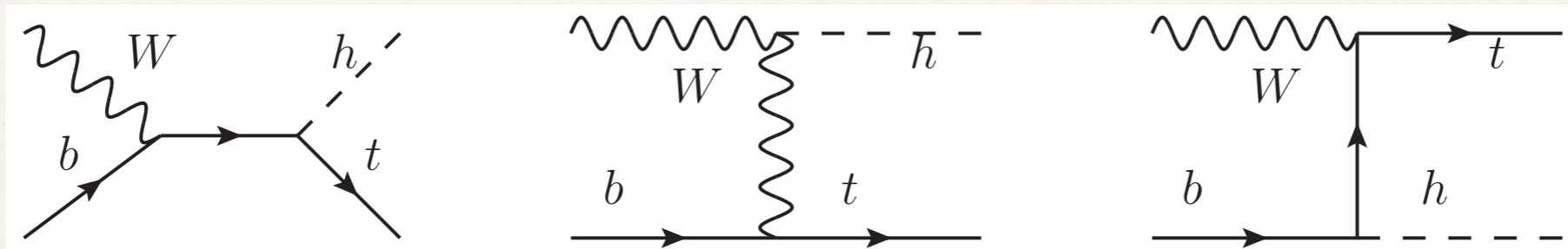
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in collaboration with M. Farina, C. Grojean, F. Maltoni, E. Salvioni
based on arXiv:1211.3736

Partonic cross section

- partonic process $Wb \rightarrow th$

suppressed by
bottom Yukawa



- high energy regime $s, -t, -u \gg m_t^2, m_W^2, m_h^2$

$$A = \frac{g}{\sqrt{2}} (c_F - c_V) \frac{m_t \sqrt{s}}{m_W v} A \left(\frac{t}{s}, \varphi; \xi_t, \xi_b \right) + \text{const}$$

$$c_V \equiv g_{hWW} / g_{hWW}^{SM}$$

$$c_F \equiv g_{ht\bar{t}} / g_{ht\bar{t}}^{SM}$$

SM: $c_V = c_F$ \Rightarrow cancellation

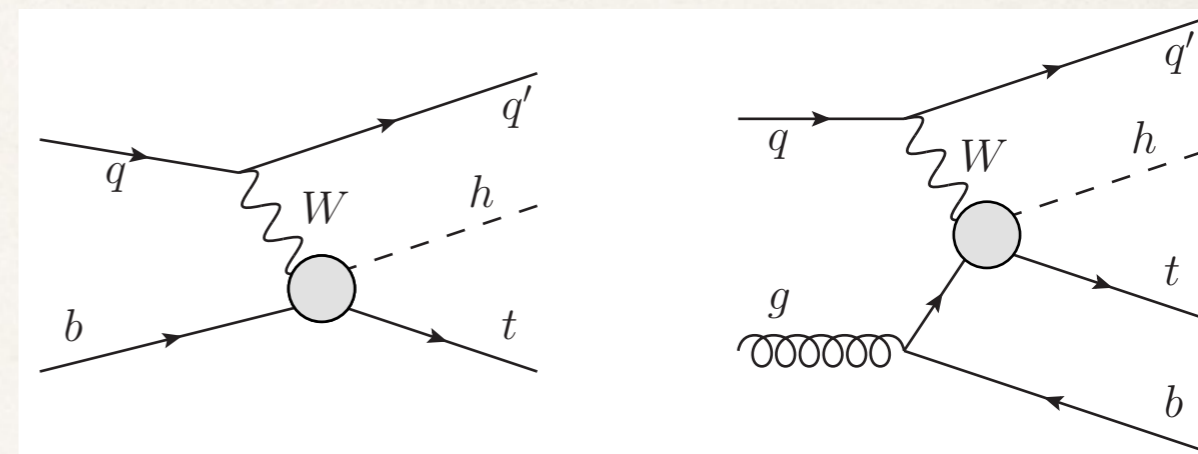
deviations: $c_V \neq c_F$ \Rightarrow enhancement

amplitude growing with energy

Total cross section

- at LHC: $pp \rightarrow thj$
 $pp \rightarrow thjb$

(b from initial gluon splitting)

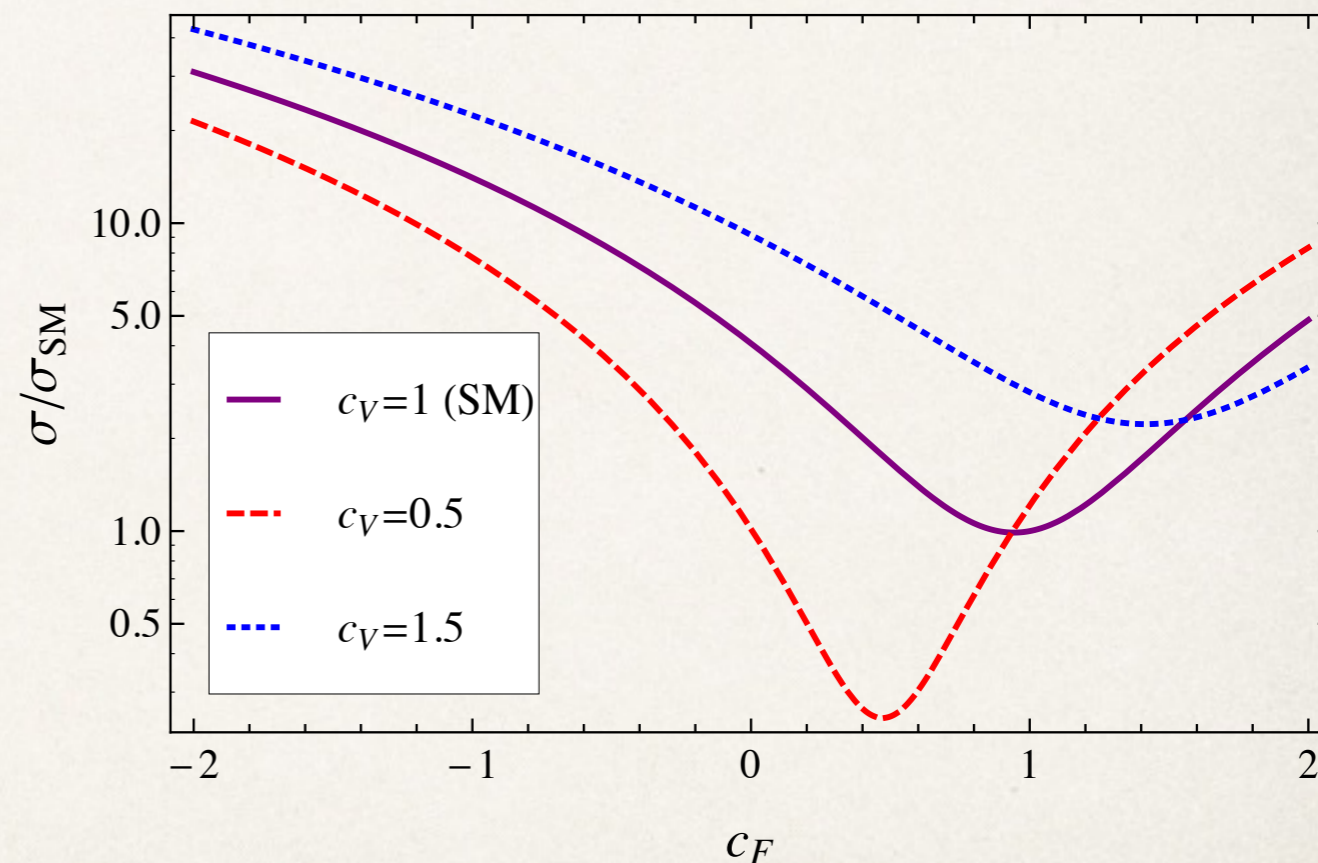


	$\sigma^{\text{LO}}(pp \rightarrow thj)$ [fb]		$\sigma^{\text{LO}}(pp \rightarrow thjb)$ [fb]	
	$c_F = 1$	$c_F = -1$	$c_F = 1$	$c_F = -1$
8 TeV	17.4	252.7	5.4	79.2
14 TeV	80.4	1042	26.9	363.5

- for $c_V = 1, c_F = -1$
enhancement of factor 10

- decays: $h \rightarrow \bar{b}b$
 $h \rightarrow \gamma\gamma, WW^*, \bar{\tau}\tau$

$pp \rightarrow thj$ (LHC 14 TeV)



[Farina, Grojean, Maltoni, Salvioni, Thamm, arXiv:1211.3736]

[Biswas, Gabrielli, Mele, arXiv:1211.0499]

[Biswas, Gabrielli, Margaroli, Mele, arXiv:1304.1822]

Parton level analysis

- ❖ assumption: semileptonically decaying top

final state with 3b tags
(from $pp \rightarrow thj$)

$3b + 1 \text{ forward jet} + \ell^\pm + E_T^{miss}$

signature

final state with 4b tags
(from $pp \rightarrow thjb$)

$4b + 1 \text{ forward jet} + \ell^\pm + E_T^{miss}$

- ❖ 4b tags at 8 TeV

Cuts	Signal		Backgrounds					
	$c_F = 1$	$c_F = -1$	Total	$tZ\bar{b}j$	$t\bar{b}\bar{b}j$	$t\bar{t}\bar{b}\bar{b}$	$t\bar{t}\bar{b}\bar{b} (mis)$	$t\bar{t}j$
Acceptance Cuts + ϵ	0.043	0.63	7.81	0.11	0.26	2.66 (0.48)	2.25	2.54
$ m_{bb} - m_h < 15 \text{ GeV}$	0.039	0.58	4.06	0.03	0.08	0.94 (0.40)	1.29	1.71
min $m_{bb} > 110 \text{ GeV}$	0.023	0.30	0.67	0.002	0.015	0.20 (0.18)	0.44	0.
min $m_{bj} > 180 \text{ GeV}$	0.008	0.15	0.014	0.	0.007	0.002 (0.001)	0.004	0.
Events at 25 fb^{-1}	0.2	3.8	0.4					

- ❖ exclusion limit for $c_F = -1$: 2.4σ at 8 TeV

6σ at 14 TeV

Comparison with CMS analysis

- ❖ analysis of $pp \rightarrow thj$, with $h \rightarrow \gamma\gamma$
8 TeV, 19.6/fb

[CMS PAS HIG-14-001]

- ❖ signal: $2\gamma + 1\text{jet} + \ell^\pm + 1b$

- ❖ 95% CL upper bound on 4.1 times the expected cross section
for $c_F = -1$