OVERVIEW OF SM HIGGS PHYSICS AND BSM EFFECTS

Felix Yu (JGU Mainz)



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Current status

 After the 125 GeV Higgs discovery, the SM has no more free parameters

 We are now in an era with a boundless set of experimental measurements, and every measurement is an opportunity to refute the SM

• Q: What do we learn from ongoing Higgs measurements?

Refresher: SM Higgs phenomenology

- The SM Higgs potential is the familiar $\lambda \phi^4$ potential $\mathcal{L} \supset |D_\mu H|^2 \mu^2 |H|^2 \lambda |H|^4$
- Spontaneous symmetry breaking of SU(2)×U(1) occurs since μ² < 0

Through the $|D_{\mu} H|^2$ term, three Goldstone fields are "eaten" and become the longitudinal modes of W[±] and Z bosons

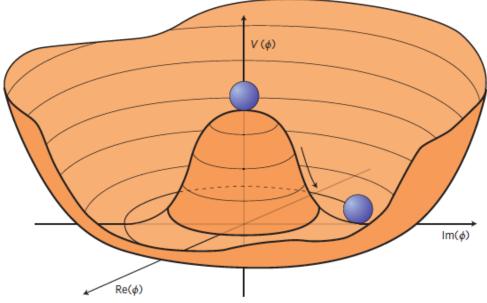


Fig. from Ellis, Gaillard, Nanopoulos, [1201.6045]

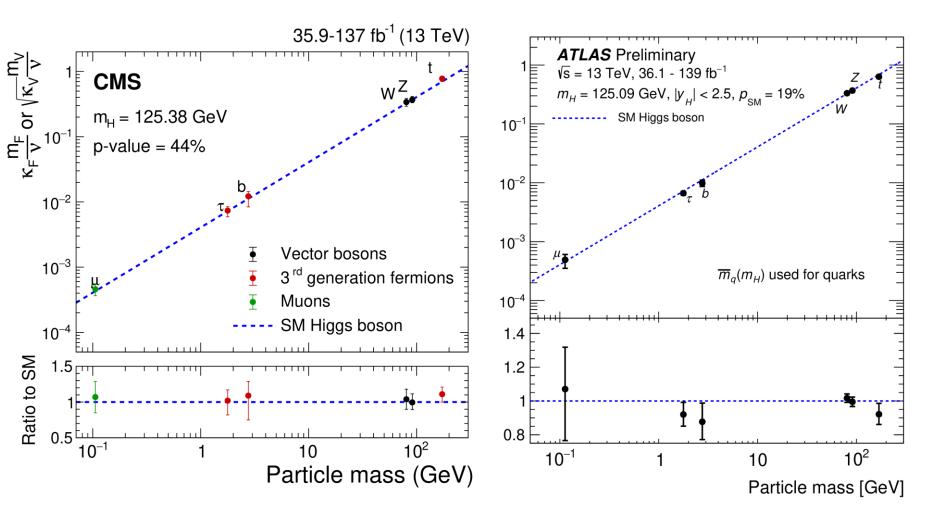
Refresher: SM Higgs phenomenology

• Chiral SM fermions only become massive after SSB

$$\mathcal{L} \supset -y_u \overline{Q}_L \tilde{H} u_R - y_d \overline{Q}_L H d_R - y_e \overline{L}_L H e_R + \text{ h.c.}$$

- Diagonalizing the arbitrary Yukawa matrices uses the global U(3)⁵ flavor symmetry, leading to V_{CKM} (and V_{PMNS} for Dirac neutrino masses)
 - Central prediction: Higgs (and Z) interactions are flavor diagonal in fermion mass basis
 - Higgs Yukawa couplings are real, proportional to fermion mass
 - Also true for Higgs couplings to massive gauge bosons

Testing SM Higgs phenomenology



CMS HIG-17-031 and updates, ATLAS-CONF-2021-053

Top-level dichotomy

- Given: the Higgs mechanism underpins the SM
 - Q: How do we conceptualize the space of BSM effects on SM Higgs physics?

Top-level dichotomy

- Given: the Higgs mechanism underpins the SM
 - Q: How do we conceptualize the space of BSM effects on SM Higgs physics?
 - A: This is the fundamental interplay at the heart of BSM Higgs phenomenology

Higgs physics touches (Most all) BSM changes (most) all of BSM Higgs physics

Key reason: |H|² is the lowest-dimension, gauge- and Lorentz-invariant operator, hence sensitive to any NP (This is also relevant for the hierarchy problem)

Non-exhaustive list of Higgs decays

- [Implicit marriage of production modes and decay]
- Thus, NP can appear in any Higgs production/decay mode
- Yukawa-mediated two-body decays
 - bb, cc, ττ, μμ, ee (tt, ss, uu, dd)
- Vector coupling-induced decays
 - 4l, lvlv, lvqq
- Loop-induced decays
 - gg, γγ, Ζγ
- Rare decays
 - $J/\psi \gamma$, Yy, $\varphi \gamma$

Non-exhaustive list of Higgs decays

- [Implicit marriage of production modes and decay]
- Thus, NP can appear in any Higgs production/decay mode
- Yukawa-mediated two-body decays Test Yukawa patterns, CPV phases - bb, cc, $\tau\tau$, $\mu\mu$, ee (tt, ss, uu, dd)
- Vector coupling-induced decays
 - Test EWSB, probe VV unitarization, additional — 41, lvlv, lvqq Higgs states, CPV
- Loop-induced decays
 - gg, γγ, Ζγ
- Rare decays
 - $J/\psi \gamma$, $\Upsilon \gamma$, $\varphi \gamma$

Test new colored states, new EM charged states

Test Yukawa couplings, loop-induced couplings

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Schopf, Arnold, Sauerburger, Tzovara, Cardini

Aggarwal

Gillwald

Example: Motivating non-standard Yukawas

- Effective dim-6 operator correction for Yukawas
 - $\mathcal{L} \supset -y_u \bar{Q}_L \tilde{H} u_R y'_u \frac{|H|^2}{\Lambda^2} \bar{Q} \tilde{H} u_R y_\ell \bar{L} H \ell_R y'_\ell \frac{|H|^2}{\Lambda^2} \bar{L} H \ell_R$ - $y_d \bar{Q}_L H d_R - y'_d \frac{|H|^2}{\Lambda^2} \bar{Q} H d_R + \text{h.c.}$ - Diagonalize the mass combinations $m_f = \frac{y_f v}{\sqrt{2}} + \frac{y'_f v^3}{2\sqrt{2}\Lambda^2}$
- Resulting Yukawa interactions are not necessarily diagonal, or CP-conserving

$$\frac{y_{f, \text{ eff}}}{\sqrt{2}} = \frac{y_f}{\sqrt{2}} + \frac{3y'_f v^2}{2\sqrt{2}\Lambda^2} = \frac{m_f}{v} + \frac{2y'_f v^2}{2\sqrt{2}\Lambda^2}$$

- Depends sensitively on symmetries assumed at dim-6
 - Fine-tune mass generation \leftrightarrow large BSM effects

New Physics Lamppost

- Two categories of searches: SM vs. SM-ish decays
 - SM Higgs decay: target sensitivity is nonzero SM prediction
 - SM-ish Higgs decay: target is testing a SM zero
 - Flavor-violating decay, CPV, exotic decay
- Logic also valid for production modes! FY [1404.2924]
 - SM vs. SM-ish production modes also need testing
 - Current framework uses STXS

In Higgs physics, any SM zero is readily *nonzero* in a NP model

Summary

- Rich and diverse program of post-discovery studies of Higgs properties at LHC
 - Mass, spin/parity, couplings, width, exotic production
 modes, exotic decay modes
 Exotic decay h → aa: Rodriguez, Hoefer (BSM session)
- Boundless set of experimental measurements, and every measurement is an opportunity to refute the SM
 - Not addressed: к-framework, EFT approach
 - Forthcoming highlight: HH studies HH results: Veatch, Deutsch
- Patterns of deviations from data will point the path to new physics scales

Motivating patterns of characteristic deviations: EFT vs. UV-complete

- Assume no light degrees of freedom, use effective operators for Higgs characterization
 - HEFT and SMEFT approaches differ in scope, but patterns of deviations require assumptions belying model dependence, symmetry assumptions for NP
 - dim-6: 76 vs. 2499 operators (global B, L conservation, one vs. three fermion generations)
 Buchmuller, Wyler NPB 268 (1986) 621 Grzadkowski, Iskrzynski, Misiak, Rosiek [1008.4884]
 Alonso, Jenkins, Manohar, Trott [1312.2014]
 - e.g. SILH basis Giudice, Grojean, Pomarol, Rattazzi [hep-ph/0703164] Liu, Pomarol, Rattazzi [1603.03064]
- Adopt concrete, robust models

- SM+singlet, 2HDM, G-M, MSSM, composite Higgs, ...

Current status

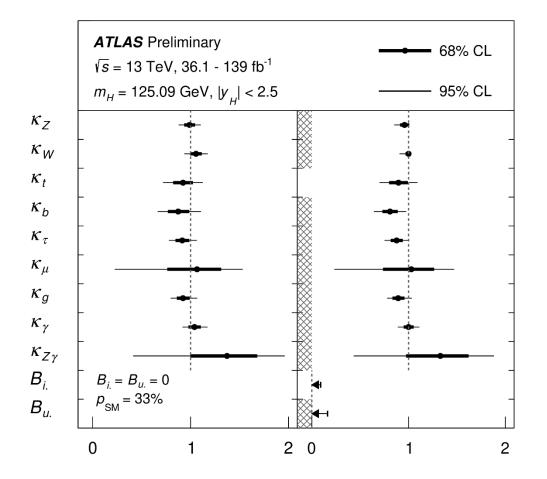
	ATLAS	Preliminary	_ · · · ·				Total S		
	√ <i>s</i> = 13 TeV,	139 fb ⁻¹	B _{γγ} /B _{ZZ} .			1.09	+0.14	+0.12 , ±0.06	
		GeV, y _H < 2.5	B ₆₈ /B ₂₂ .			0.78	+0.28	+0.23 +0.16)
	p = 92%		B _{WW} /B _{ZZ} .		-	1.06	+0.14	+0.11 +0.09	
		21.1	B _{TT} /B _{ZZ*}	H.		0.86	+0.16	+0.12 +0.10	эП
	Total Stat.		L <u>.</u>	0.5		1.5	-0.14 (-0.10 - 0.03	ĹΙ
	Sysi.	SM	0	0.5	1	1.5		Stat. Syst.	_
	$gg \rightarrow H \times B_{Z^*}$	0-jet, $p_{\tau}^{H} < 10 \text{ GeV}$ 0-jet, $10 \le p_{\tau}^{T} < 200 \text{ GeV}$ 1-jet, $p_{\tau}^{H} < 60 \text{ GeV}$ 1-jet, $60 \le p_{\tau}^{T} < 120 \text{ GeV}$ 1-jet, $120 \le p_{\tau}^{H} < 200 \text{ GeV}$ 2-jet, $m_{\eta} < 350 \text{ GeV}, p_{\tau}^{H} < 60 \text{ GeV}$				0.89 1.14 0.57 1.06 0.66	$\begin{array}{c} + 0.22 \\ - 0.20 \\ + 0.15 \\ - 0.14 \end{array} (\\ \pm 0.28 \\ - 0.27 \\ + 0.27 \\ + 0.41 \\ - 0.39 \end{array} (\end{array}$	$\begin{array}{c} + 0.19 & + 0.11 \\ - 0.18 & - 0.10 \\ \pm 0.12 & + 0.09 \\ - 0.07 & + 0.22 \\ - 0.21 & , \pm 0.18 \\ + 0.25 & + 0.13 \\ - 0.24 & - 0.12 \\ + 0.36 & + 0.19 \\ - 0.35 & - 0.17 \end{array}$) ()))
		$\begin{split} & = 2 \operatorname{-jent} m_{\tilde{g}} < 350 \operatorname{GeV}, p_{T} < 360 \operatorname{GeV}, \\ & \geq 2 \operatorname{-jet}, m_{\tilde{g}} < 350 \operatorname{GeV}, 60 \leq p_{T}^{H} < 120 \operatorname{GeV} \\ & \geq 2 \operatorname{-jet}, m_{\tilde{g}} < 350 \operatorname{GeV}, 120 \leq p_{T}^{H} < 200 \operatorname{GeV} \\ & \geq 2 \operatorname{-jet}, m_{\tilde{g}} \geq 700 \operatorname{GeV}, p_{T}^{H} < 200 \operatorname{GeV} \\ & \geq 2 \operatorname{-jet}, m_{\tilde{g}} \geq 700 \operatorname{GeV}, p_{T}^{H} < 200 \operatorname{GeV} \\ & 200 \leq p_{T}^{H} < 300 \operatorname{GeV} \\ & 300 \leq p_{T}^{H} < 450 \operatorname{GeV} \\ & p_{T}^{H} \geq 450 \operatorname{GeV} \\ & p_{T}^{H} \geq 450 \operatorname{GeV} \end{split}$			H	0.47 0.25 0.54 2.76 0.74 1.06 0.65 1.86	± 0.53 (+0.44 -0.42 (+1.11 -1.04 (+1.54 -1.43 (+0.35 ($\begin{array}{c} \pm 0.98 \begin{array}{c} +0.47 \\ -0.39 \end{array} \\ \pm 0.46 \begin{array}{c} \pm 0.28 \\ -0.39 \end{array} \\ -0.36 \end{array} \\ -0.36 \end{array} \\ -0.36 \end{array} \\ -0.22 \\ -0.93 \end{array} \\ -0.45 \\ -0.93 \\ -0.45 \\ -0.42 \end{array} \\ -0.45 \\ $;))))
	$qq \rightarrow Hqq \times B_{ZZ}$.	$ \begin{split} &\leq 1\text{-jet} \\ &\geq 2\text{-jet}, \ m_g < 350 \ \text{GeV}, \ VH \ \text{veto} \\ &\geq 2\text{-jet}, \ m_g < 350 \ \text{GeV}, \ VH \ \text{topo} \\ &\geq 2\text{-jet}, \ m_g < 350 \ \text{GeV}, \ VH \ \text{topo} \\ &\geq 2\text{-jet}, \ 350 \le m_g < 700 \ \text{GeV}, \ p_{\tau}^H < 200 \ \text{GeV} \\ &\geq 2\text{-jet}, \ 700 \le m_g < 1000 \ \text{GeV}, \ p_{\tau}^H < 200 \ \text{GeV} \\ &\geq 2\text{-jet}, \ 1000 \le m_g < 1500 \ \text{GeV}, \ p_{\tau}^H < 200 \ \text{GeV} \\ &\geq 2\text{-jet}, \ m_g \ge 1500 \ \text{GeV}, \ p_{\tau}^H < 200 \ \text{GeV} \\ &\geq 2\text{-jet}, \ m_g \ge 350 \ \text{GeV}, \ p_{\tau}^H \ge 200 \ \text{GeV} \end{split} $	/ •		— •	1.40 2.98 1.00 0.33 0.95 1.38 1.15 1.21	+ 1.64 (- 1.52 (+ 0.58 (- 0.52 (+ 0.49 (+ 0.49 (+ 0.71 (+ 0.57 (+ 0.57 (+ 0.39 (- 0.39 ($\begin{array}{cccc} + 0.40 \\ - 0.93 & - 0.35 \\ + 1.46 & + 0.75 \\ - 1.37 & - 0.66 \\ - 0.47 & - 0.23 \\ + 0.44 & + 0.22 \\ - 0.41 & - 0.24 \\ + 0.62 & + 0.35 \\ - 0.41 & - 0.24 \\ + 0.62 & + 0.35 \\ - 0.57 & - 0.31 \\ + 0.35 & + 0.18 \\ - 0.32 & - 0.14 \\ + 0.35 & + 0.18 \\ - 0.32 & - 0.14 \\ - 0.32 & - 0.14 \\ - 0.24 & - 0.12 \\ \end{array}$)))))
	qq→Hiv×B _{ZZ*} .	$\begin{split} p_{T}^{\nu} < 75 \text{ GeV} \\ 75 &\leq p_{T}^{\nu} < 150 \text{ GeV} \\ 150 &\leq p_{T}^{\nu} < 250 \text{ GeV} \\ 250 &\leq p_{T}^{\nu} < 400 \text{ GeV} \\ p_{T}^{\nu} &\geq 400 \text{ GeV} \end{split}$				2.47 1.64 1.42 1.36 1.91	+0.99 -0.80 +0.74 -0.58 +0.72 -0.53	$\begin{array}{c} +1.15 & +0.22 \\ -1.02 & -0.12 \\ +0.97 & +0.20 \\ -0.79 & -0.12 \\ +0.61 & +0.42 \\ -0.48 & -0.33 \\ +0.63 & +0.35 \\ -0.48 & -0.22 \\ +1.22 & +0.79 \\ -0.95 & -0.50 \end{array}$)))
	gg/qq→Hll × B _{zz} ,	$\begin{array}{c} p_{\tau}^{\nu} < 150 \; \mathrm{GeV} \\ 150 \leq p_{\tau}^{\nu} < 250 \; \mathrm{GeV} \\ 250 \leq p_{\tau}^{\nu} < 400 \; \mathrm{GeV} \\ p_{\tau}^{\nu} \geq 400 \; \mathrm{GeV} \end{array}$		∎ ∎ -		0.21 1.30 1.28 0.39	+ 0.63 - 0.46 (+ 0.73 - 0.54 ($\begin{array}{c} \pm 0.54 & +0.46 \\ -0.53 & +0.53 \\ +0.53 & +0.34 \\ -0.41 & -0.22 \\ +0.64 & +0.36 \\ -0.48 & -0.23 \\ +1.04 & +0.74 \\ -0.91 & -0.68 \end{array}$)
	tĨH×B _{Z2*}	$\begin{array}{l} p_{T}^{H} < 60 \; \mathrm{GeV} \\ 60 \leq p_{T}^{H} < 120 \; \mathrm{GeV} \\ 120 \leq p_{T}^{H} < 200 \; \mathrm{GeV} \\ 200 \leq p_{T}^{H} < 300 \; \mathrm{GeV} \\ 300 \leq p_{T}^{H} < 450 \; \mathrm{GeV} \\ p_{T}^{H} \geq 450 \; \mathrm{GeV} \end{array}$) }(0.75 0.69 0.86 0.96 0.28 0.16	- 0.66 (+ 0.53 (+ 0.55 (+ 0.55 (+ 0.62 (+ 0.79 ($\begin{array}{c} +0.72 & +0.29 \\ -0.63 & -0.21 \\ +0.49 & +0.20 \\ -0.42 & -0.15 \\ +0.50 & +0.23 \\ -0.43 & -0.19 \\ +0.56 & +0.25 \\ -0.48 & -0.20 \\ +0.66 & +0.43 \\ -0.59 & -0.38 \\ +1.44 & +1.28 \\ -1.24 & -1.25 \end{array}$))))
	$tH \times B_{ZZ^*}$					2.90	+ 3.63 - 2.87 (+ 3.35 + 1.39 - 2.73 *- 0.89)
E	- 8 –	6 -4 -2	0	2	4	6	8	1	0

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Parameter normalised to SM value

Current K-framework measurements



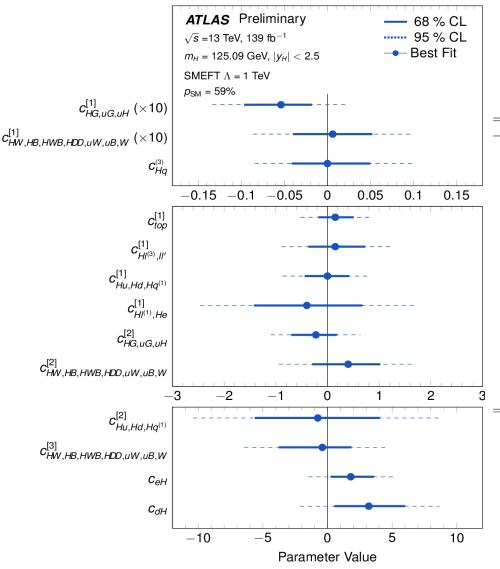
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Current K-framework measurements

Production	Tana	Main	Effective	Resolved modifier		
cross section	Loops	interference	modifier	Resolved modifier		
$\sigma(\text{ggF})$	\checkmark	t-b	κ_g^2	$1.040\kappa_t^2 + 0.002\kappa_b^2 - 0.038\kappa_t\kappa_b - 0.005\kappa_t\kappa_c$		
$\sigma(\text{VBF})$	-	-	-	$0.733 \kappa_W^2 + 0.267 \kappa_Z^2$		
$\sigma(qq/qg \to ZH)$	-	-	-	κ_Z^2		
$\sigma(gg\to ZH)$	\checkmark	t-Z	$\kappa_{(ggZH)}$	$2.456 \kappa_Z^2 + 0.456 \kappa_t^2 - 1.903 \kappa_Z \kappa_t \\ - 0.011 \kappa_Z \kappa_b + 0.003 \kappa_t \kappa_b$		
$\sigma(WH)$	-	-	-	κ_W^2		
$\sigma(H)$	-	-	-	κ_t^2		
$\sigma(tHW)$	-	t–W	-	$2.909\kappa_t^2 + 2.310\kappa_W^2 - 4.220\kappa_t\kappa_W$		
$\sigma(tHq)$	-	t–W	-	$2.633 \kappa_t^2 + 3.578 \kappa_W^2 - 5.211 \kappa_t \kappa_W$		
$\sigma(H)$	-	-	-	κ_b^2		
Partial decay wid	th					
Γ^{bb}	-	-	-	κ_b^2		
Γ^{WW}	-	-	-	κ_W^2		
Γ^{gg}	\checkmark	t- b	κ_q^2	$1.111 \kappa_t^2 + 0.012 \kappa_b^2 - 0.123 \kappa_t \kappa_b$		
$\Gamma^{\tau\tau}$	-	-	-	$\kappa_{ au}^2$		
Γ^{ZZ}	-	-	-	κ_Z^2		
Γ^{cc}	-	-	-	$\kappa_c^2 \ (= \kappa_t^2)$		
				$1.589\kappa_W^2 + 0.072\kappa_t^2 - 0.674\kappa_W\kappa_t$		
$\Gamma^{\gamma\gamma}$	\checkmark	t–W	κ_{γ}^2	$+0.009 \kappa_W \kappa_ au + 0.008 \kappa_W \kappa_b$		
			,	$-0.002 \kappa_t \kappa_b - 0.002 \kappa_t \kappa_\tau$		
$\Gamma^{Z\gamma}$	\checkmark	t–W	$\kappa^2_{(Z\gamma)}$	$1.118\kappa_W^2 - 0.125\kappa_W\kappa_t + 0.004\kappa_t^2 + 0.003\kappa_W\kappa_b$		
Γ^{ss}	-	-	-	$\kappa_s^2 \ (= \kappa_b^2)$		
$\Gamma^{\mu\mu}$	-	-	-	κ_{μ}^2		
Total width $(B_{i.} = B_{u.} = 0)$						
Γ_H		-	κ_{H}^{2}	$\begin{aligned} & 0.581 \kappa_b^2 + 0.215 \kappa_W^2 + 0.082 \kappa_g^2 \\ & + 0.063 \kappa_\tau^2 + 0.026 \kappa_Z^2 + 0.029 \kappa_c^2 \\ & + 0.0023 \kappa_\gamma^2 + 0.0015 \kappa_{(Z\gamma)}^2 \\ & + 0.0004 \kappa_s^2 + 0.00022 \kappa_\mu^2 \end{aligned}$		

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EFT Interpretation



Wilson coefficient	Operator	Wilson coefficient	Operator
$c_{H\square}$	$(H^{\dagger}H)\Box(H^{\dagger}H)$	c_{uG}	$(\bar{q}_p \sigma^{\mu\nu} T^A u_r) \widetilde{H} G^A_{\mu\nu}$
c_{HDD}	$\left(H^{\dagger}D^{\mu}H ight)^{*}\left(H^{\dagger}D_{\mu}H ight)$	c_{uW}	$(\bar{q}_p \sigma^{\mu\nu} u_r) \tau^I \widetilde{H} W^I_{\mu\nu}$
c_{HG}	$H^\dagger HG^A_{\mu u}G^{A\mu u}$	C_{uB}	$(\bar{q}_p \sigma^{\mu\nu} u_r) \widetilde{H} B_{\mu\nu}$
c_{HB}	$H^\dagger H B_{\mu u}B^{\mu u}$	c'_{ll}	$(\bar{l}_p \gamma_\mu l_t) (\bar{l}_r \gamma^\mu l_s)$
c_{HW}	$H^{\dagger}H W^{I}_{\mu u}W^{I\mu u}$	$c_{qq}^{(1)}$	$(\bar{q}_p \gamma_\mu q_t) (\bar{q}_r \gamma^\mu q_s)$
c_{HWB}	$H^{\dagger} au^{I} H W^{I}_{\mu u} B^{\mu u}$	$c^{(1)}_{oldsymbol{q}oldsymbol{q}}_{oldsymbol{q}oldsymbol{q}}_{oldsymbol{q}oldsymbol{q}}$	$(\bar{q}_p \gamma_\mu \tau^I q_r) (\bar{q}_s \gamma^\mu \tau^I q_t)$
c_{eH}	$(H^{\dagger}H)(\bar{l}_{p}e_{r}H)$	c_{qq}	$(\bar{q}_p \gamma_\mu q_t) (\bar{q}_r \gamma^\mu q_s)$
c_{uH}	$(H^{\dagger}H)(\bar{q}_p u_r \widetilde{H})$	$c_{qq}^{(31)}$	$(\bar{q}_p\gamma_\mu\tau^I q_t)(\bar{q}_r\gamma^\mu\tau^I q_s)$
c_{dH}	$(H^{\dagger}H)(\bar{q}_p d_r \widetilde{H})$	c _{uu}	$(\bar{u}_p \gamma_\mu u_r)(\bar{u}_s \gamma^\mu u_t)$
$c_{Hl}^{\scriptscriptstyle (1)}$	$(H^{\dagger}i\overleftrightarrow{D}_{\mu}H)(\bar{l}_{p}\gamma^{\mu}l_{r})$	$c_{uu}^{(1)}$	$(\bar{u}_p \gamma_\mu u_t)(\bar{u}_r \gamma^\mu u_s)$
$c_{Hl}^{\scriptscriptstyle (3)}$	$(H^{\dagger}i\overleftrightarrow{D}_{\mu}^{I}H)(\bar{l}_{p}\tau^{I}\gamma^{\mu}l_{r})$	$C_{qu}^{(1)}$	$(\bar{q}_p\gamma_\mu q_t)(\bar{u}_r\gamma^\mu u_s)$
c_{He}	$(H^{\dagger}i\overleftrightarrow{D}_{\mu}H)(\bar{e}_{p}\gamma^{\mu}e_{r})$	$c_{ud}^{(8)}$	$(\bar{u}_p \gamma_\mu T^A u_r) (\bar{d}_s \gamma^\mu T^A d_t)$
$c_{Hq}^{(1)}$	$(H^{\dagger}i\overleftrightarrow{D}_{\mu}H)(\bar{q}_{p}\gamma^{\mu}q_{r})$	$C_{qu}^{(8)}$	$(\bar{q}_p\gamma_\mu T^A q_r)(\bar{u}_s\gamma^\mu T^A u_t)$
$c_{Hq}^{(3)}$	$(H^{\dagger}i\overleftrightarrow{D}_{\mu}^{I}H)(\bar{q}_{p}\tau^{I}\gamma^{\mu}q_{r})$	$c_{qd}^{\scriptscriptstyle (8)}$	$(\bar{q}_p\gamma_\mu T^A q_r)(\bar{d}_s\gamma^\mu T^A d_t)$
c _{Hu}	$(H^{\dagger}i\overleftrightarrow{D}_{\mu}H)(\bar{u}_{p}\gamma^{\mu}u_{r})$	c_W	$\epsilon^{IJK}W^{I u}_{\mu}W^{J ho}_{ u}W^{K\mu}_{ ho}$
c_{Hd}	$(H^{\dagger}i\overleftrightarrow{D}_{\mu}H)(\bar{d}_{p}\gamma^{\mu}d_{r})$	c_G	$f^{ABC}G^{A\nu}_{\mu}G^{B\rho}_{\nu}G^{C\mu}_{\rho}$

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EFT Interpretation

Model Parameter Observed		Expected				
$(\Lambda = 1 \text{ TeV})$	Best-fit	68% CI	95% CI	68% CI	95% CI	
$c_{Hq}^{\scriptscriptstyle (3)}$	0.0	[-0.04, 0.05]	[-0.08, 0.1]	[-0.04, 0.05]	[-0.08, 0.09]	-
C _{dH}	3.2	[0.5, 6]	[-2.1,9]	[-2.7, 2.7]	[-5, 5]	
C _{eH}	1.8	[0.23, 4]	[-1.5, 5]	[-1.7, 1.7]	[-3.5, 3.2]	
$c_{HW,HB,HWB,HDD,uW,uB,W}^{[1]}$	0.001	[-0.004, 0.005]	[-0.009, 0.01]	[-0.005, 0.004]	[-0.009, 0.009]	
$c_{HW,HB,HWB,HDD,uW,uB,W}^{[2]}$	0.4	[-0.30, 1.0]	[-0.9, 1.7]	[-0.6, 0.6]	[-1.3, 1.3]	
$c_{HW,HB,HWB,HDD,uW,uB,W}^{[3]}$	-0.4	[-4, 1.9]	[-6, 5]	[-2.7, 2.8]	[-5, 6]	
$c^{[1]}_{Hl^{(1)},He}$	-0.4	[-1.4, 0.7]	[-2.5, 1.7]	[-1.0, 1.0]	[-2.0, 2.0]	
$c^{[1]}_{Hu,Hd,Hq^{(1)}}$	0.0	[-0.4, 0.4]	[-0.9, 0.8]	[-0.4, 0.4]	[-0.9, 0.8]	
$c^{[2]}_{Hu,Hd,Hq^{(1)}}$	-0.8	[-6,4]	[-10, 9]	[-5, 5]	[-10, 10]	
$c^{[1]}_{Hl^{(3)},ll'}$	0.15	[-0.4, 0.7]	[-0.9, 1.3]	[-0.5, 0.5]	[-1.0, 1.0]	
$c^{[1]}_{HG,uG,uH}$	-0.005	[-0.01, -0.0018]	[-0.013, 0.0021]	[-0.004, 0.004]	[-0.008, 0.008]	
$c^{[2]}_{HG,uG,uH}$	-0.23	[-0.7, 0.18]	[-1.1, 0.6]	[-0.4, 0.5]	[-0.9, 0.9]	
$c_{top}^{[1]}$	0.15	[-0.18, 0.5]	[-0.5, 0.8]	[-0.4, 0.4]	[-0.7, 0.7]	ATLAS-CO