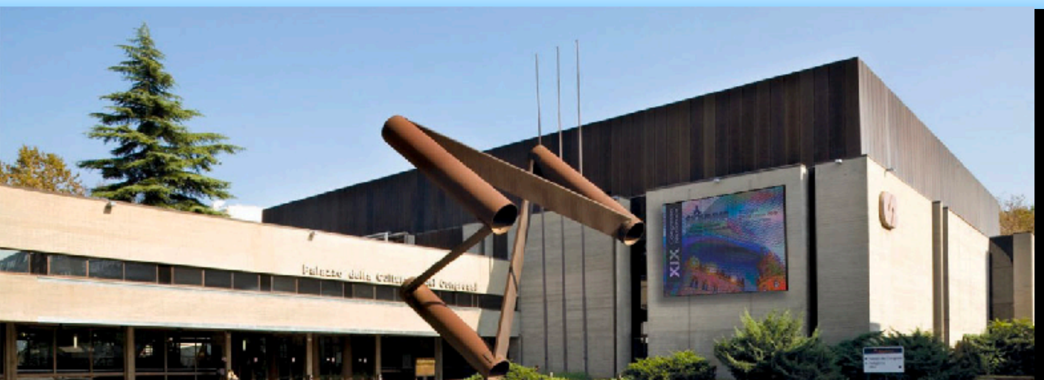
Effective Field Theory interpretations of Higgs boson measurements by the ATLAS experiment

Sandra Kortner
on behalf of the ATLAS Collaboration

MAX-PLANCK-INSTITUT FÜR PHYSIK

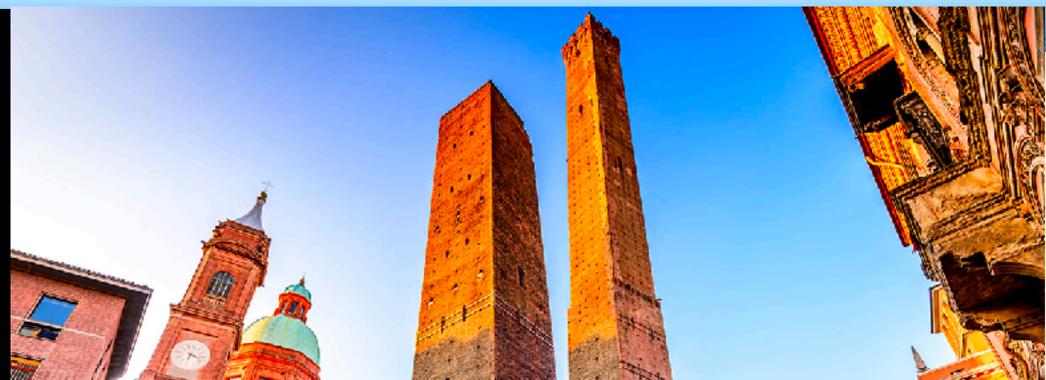
ATLAS EXPERIMENT



ICHEP 2022 BOLOGNA

ICHEP 2022
XLI
International Conference
on High Energy Physics
Bologna (Italy)

6
13 07 2022



Introduction

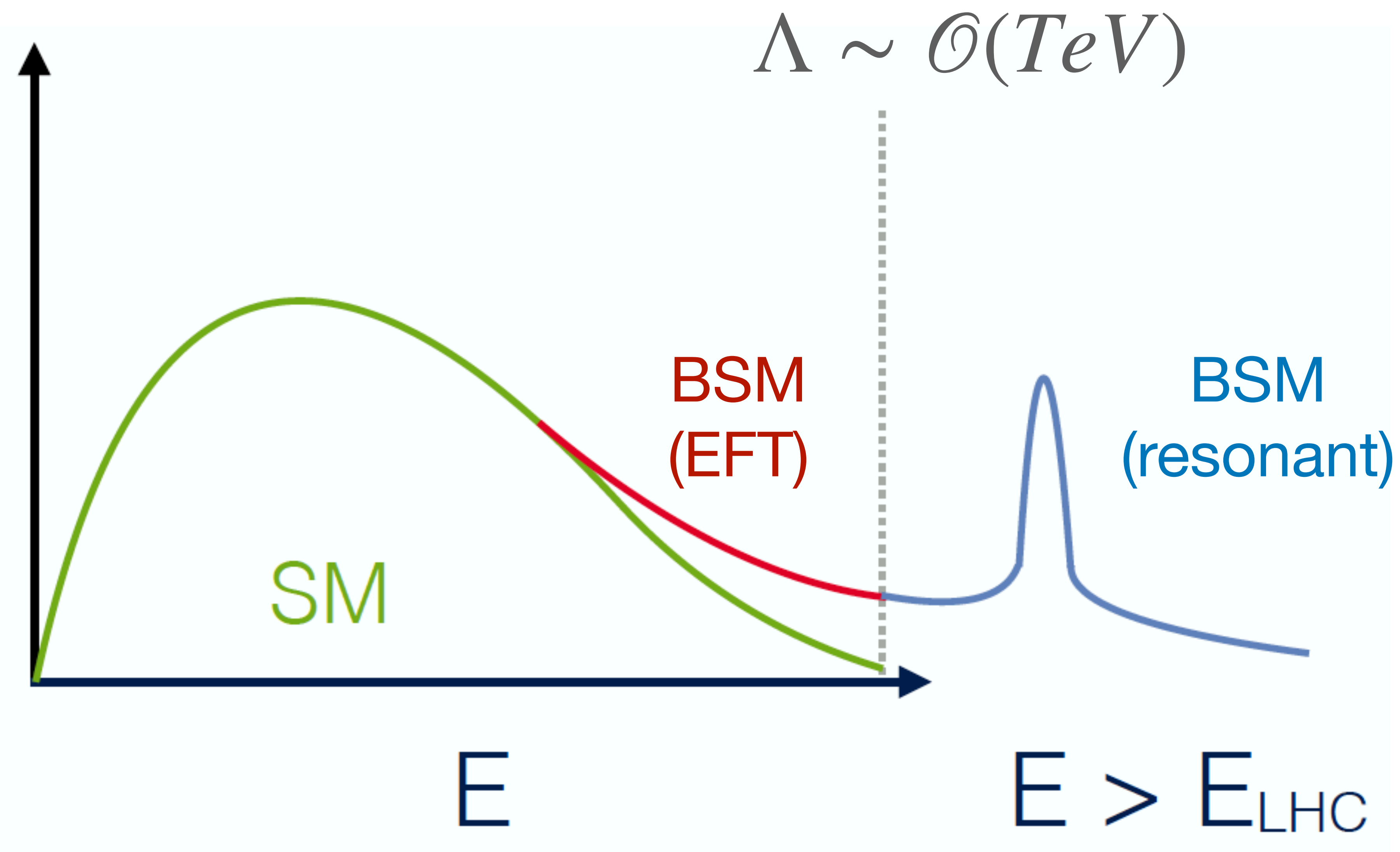
Without any direct evidence of new physics beyond the SM so far,
the SM may be viewed as a low-energy approximation to a more fundamental theory.

- Linearly realized SM Effective Field Theory (SMEFT):

$$\mathscr{L} = \mathscr{L}_{SM} + \sum_i \frac{C_i^{(d)}}{\Lambda^{d-4}} \mathcal{O}_i^{(d)}$$

If lepton and baryon number is conserved, dimension-6 terms dominate.

Deviations from the SM:
higher-dimension operators $\mathcal{O}_i^{(d)}$, suppressed by powers of Λ.
Wilson coefficients $C_i^{(d)}$ are free parameters, correlated to each other



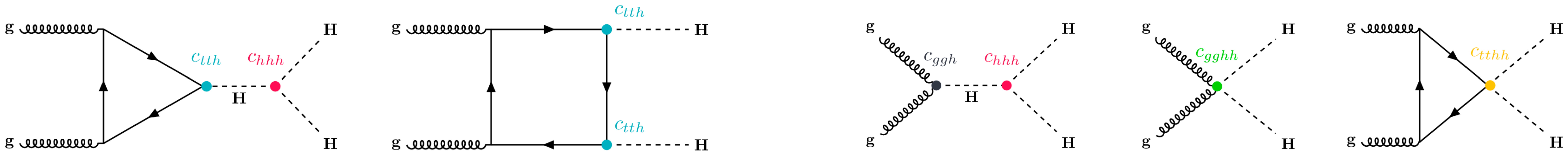
- Non-linearly realized Higgs Effective Field Theory (HEFT):

More general (encompassing SMEFT): Higgs and EW Goldstone bosons are treated independently.
Free parameters of the theory are not correlated.

HEFT interpretation of Higgs boson pair searches

ATLAS-PHYS-PUB-2022-019

Interpreting searches for the Higgs pair production in $bb\tau\tau$ and $bb\gamma\gamma$ final states, and their combination.

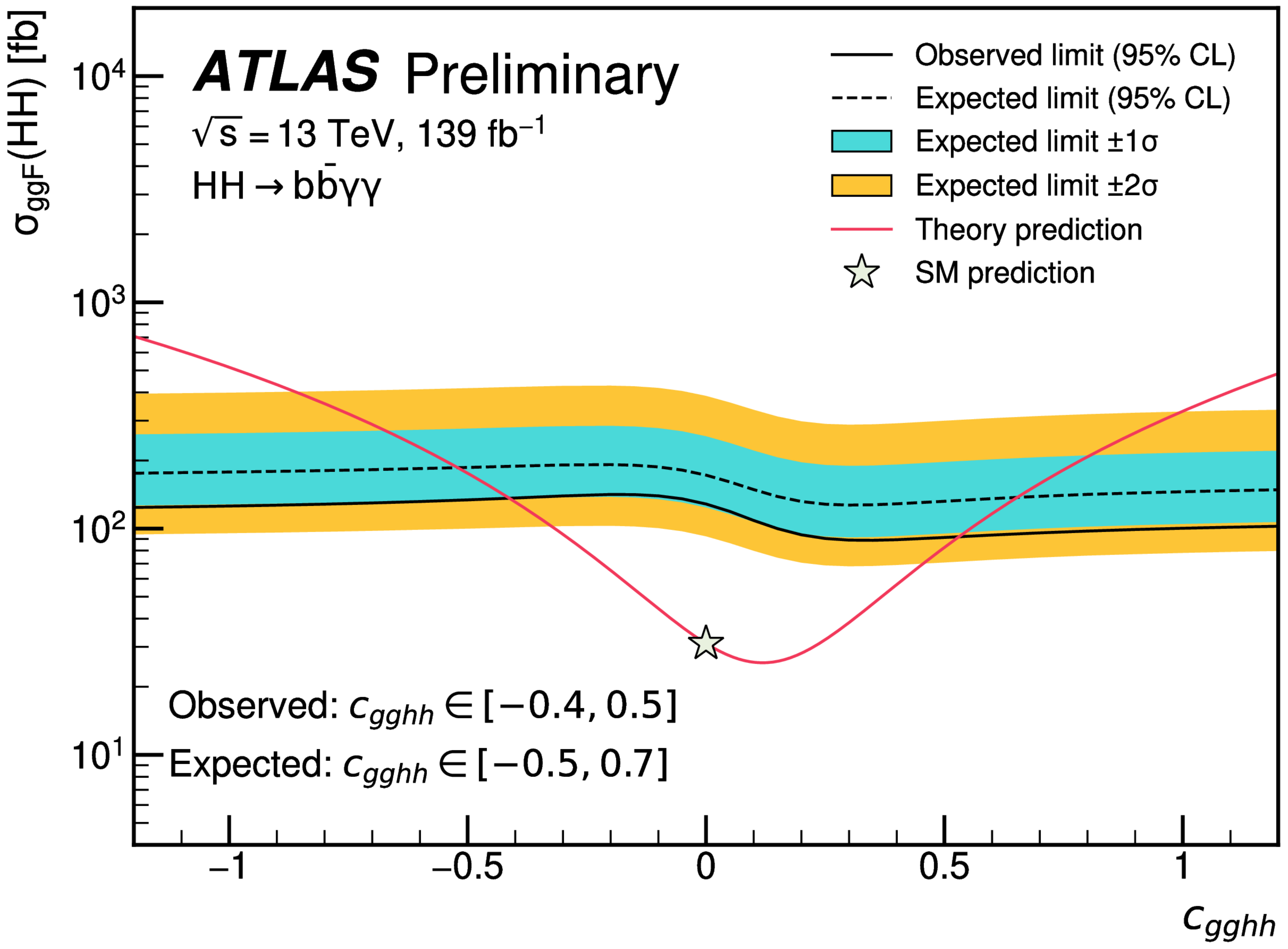


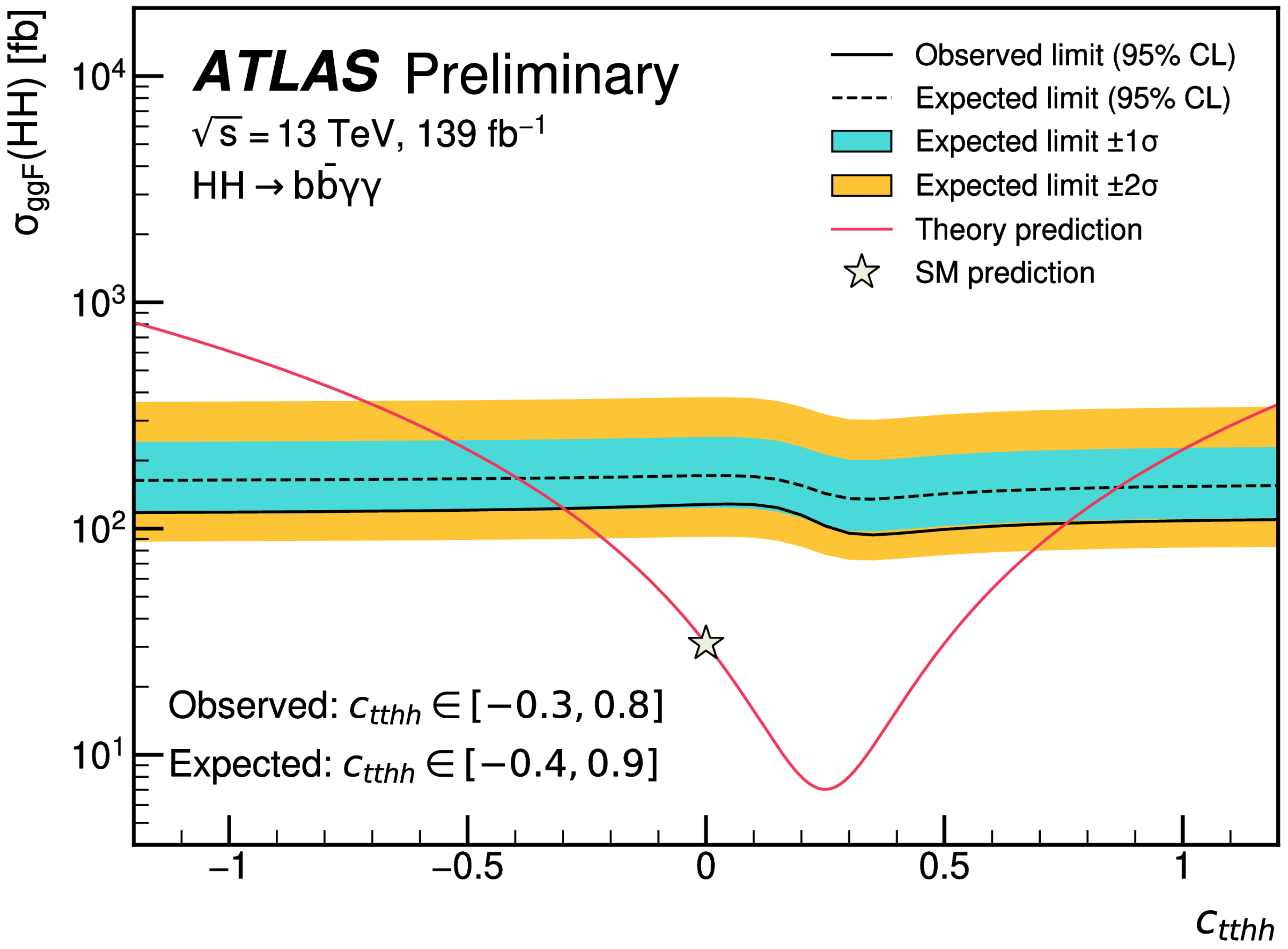
- Upper limits at 95% CL on $gg \to HH$ production cross section for seven HEFT benchmark scenarios (with different m_{HH} spectra): 50.4 fb (46.0 fb expected) to 135.1 fb (135.1 expected).

- Allowed range for c_{hhh} ($\equiv \kappa_\lambda$) from ATLAS-CONF-2021-052
  (-1.0, 6.6) observed,
  (-1.2, 7.2) expected.

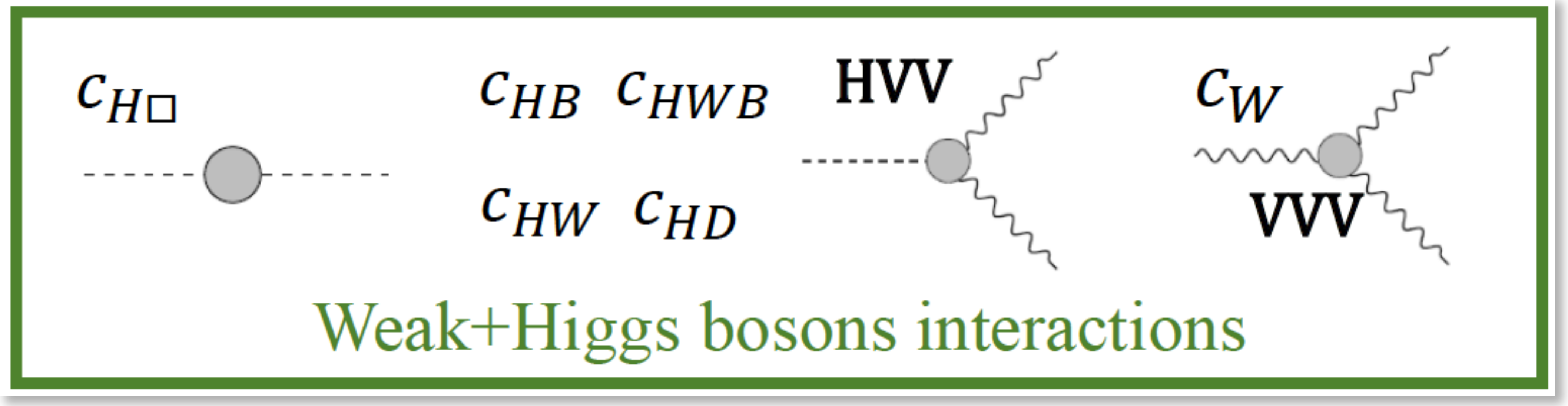
- Constraints on HEFT coupling parameters c_{gghh} and c_{tthh}:

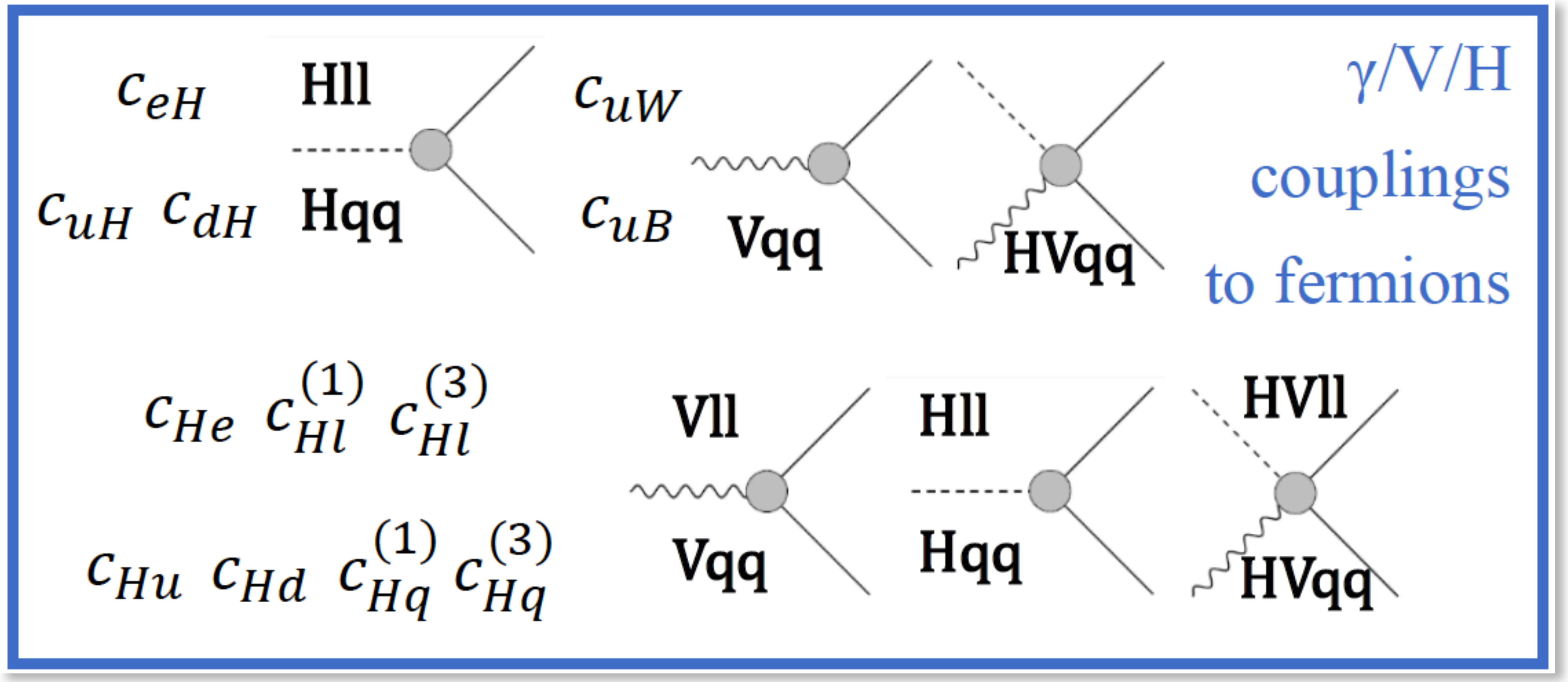
  Simultaneous constraints needed for more model-independence.

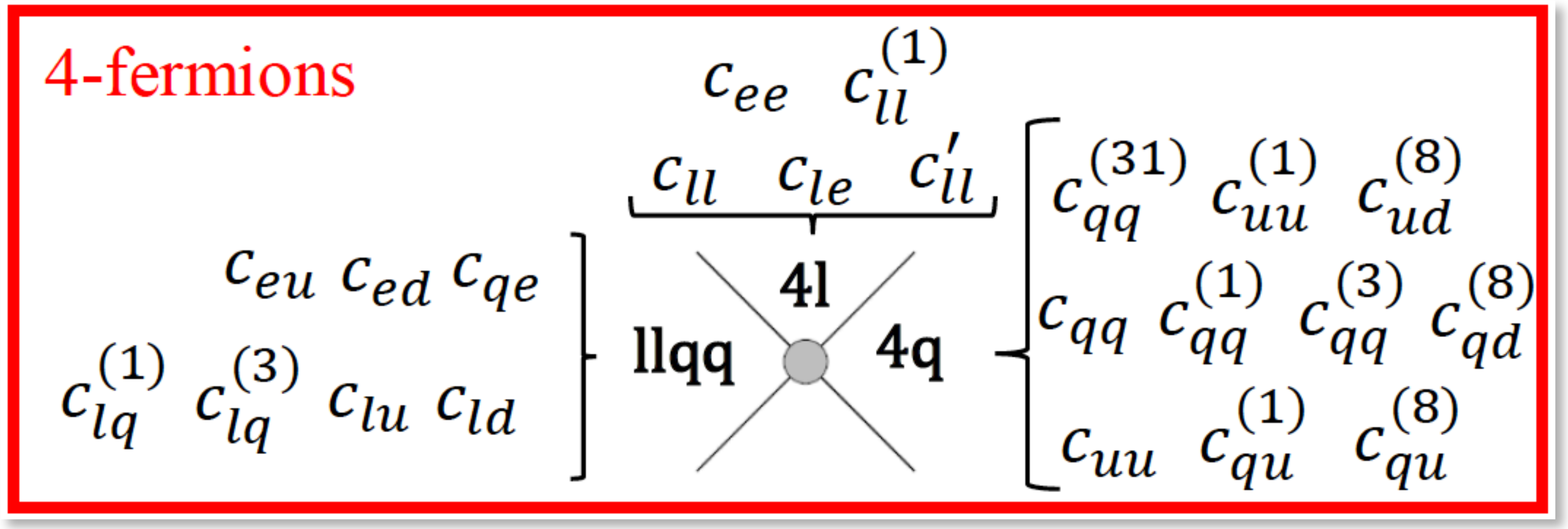




SMEFT interpretations of single-Higgs measurements







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

Assuming $U(3)^5 = U(3)_q \times U(3)_u \times U(3)_d \times U(3)_l \times U(3)_e$ flavour symmetry.

$H \to \gamma\gamma$ differential and fiducial cross sections in SMEFT

arXiv:2202.00487

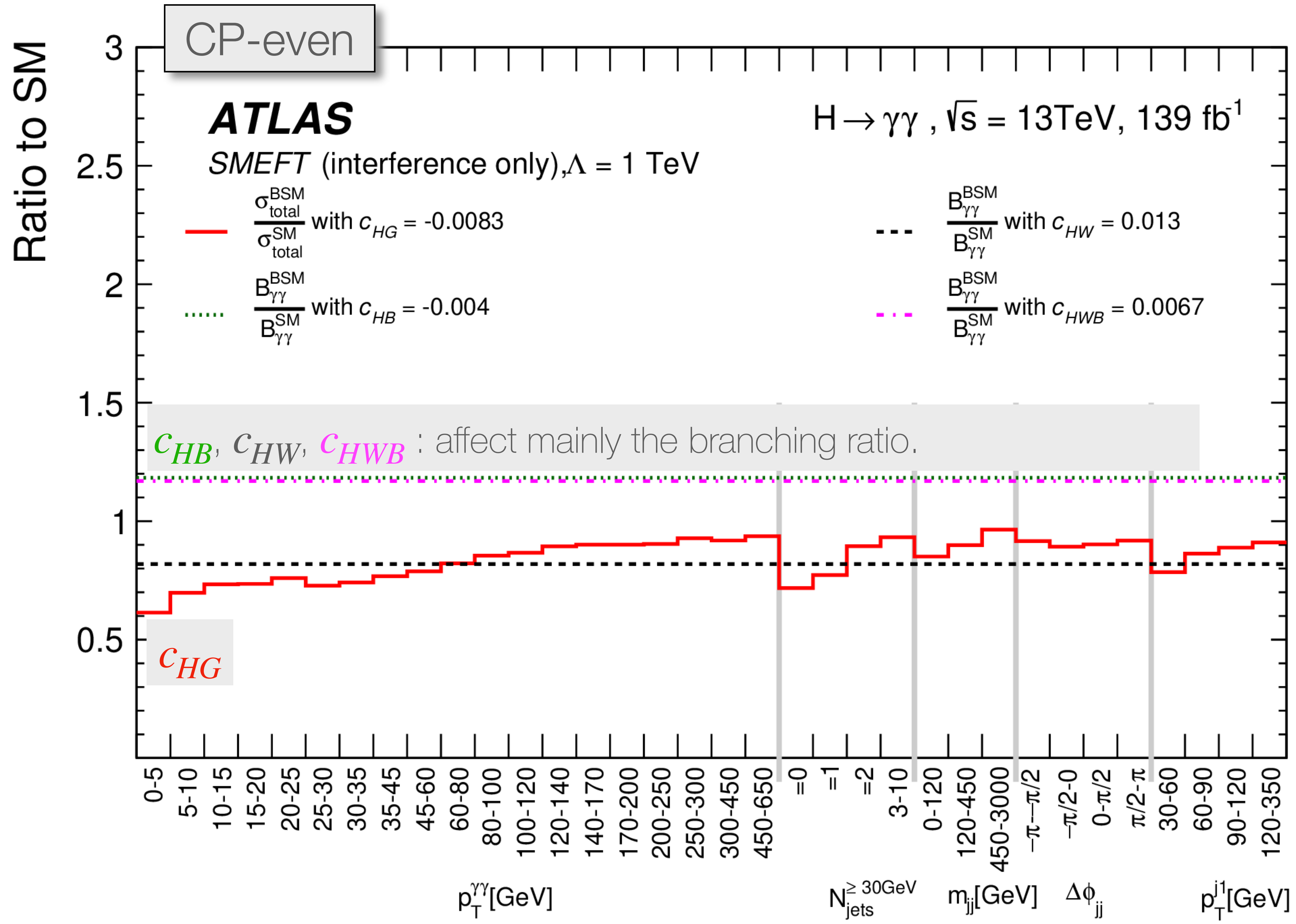
SMEFT cross section parametrization: $\sigma B = (\sigma B)_{SM}\left(1 + \sum_i A_i^{(6)} \frac{C_i^{(6)}}{\Lambda^2} + \sum_{ij} B_{ij}^{(6)} \frac{C_i^{(6)} C_j^{(6)}}{\Lambda^4} + \ldots\right)$

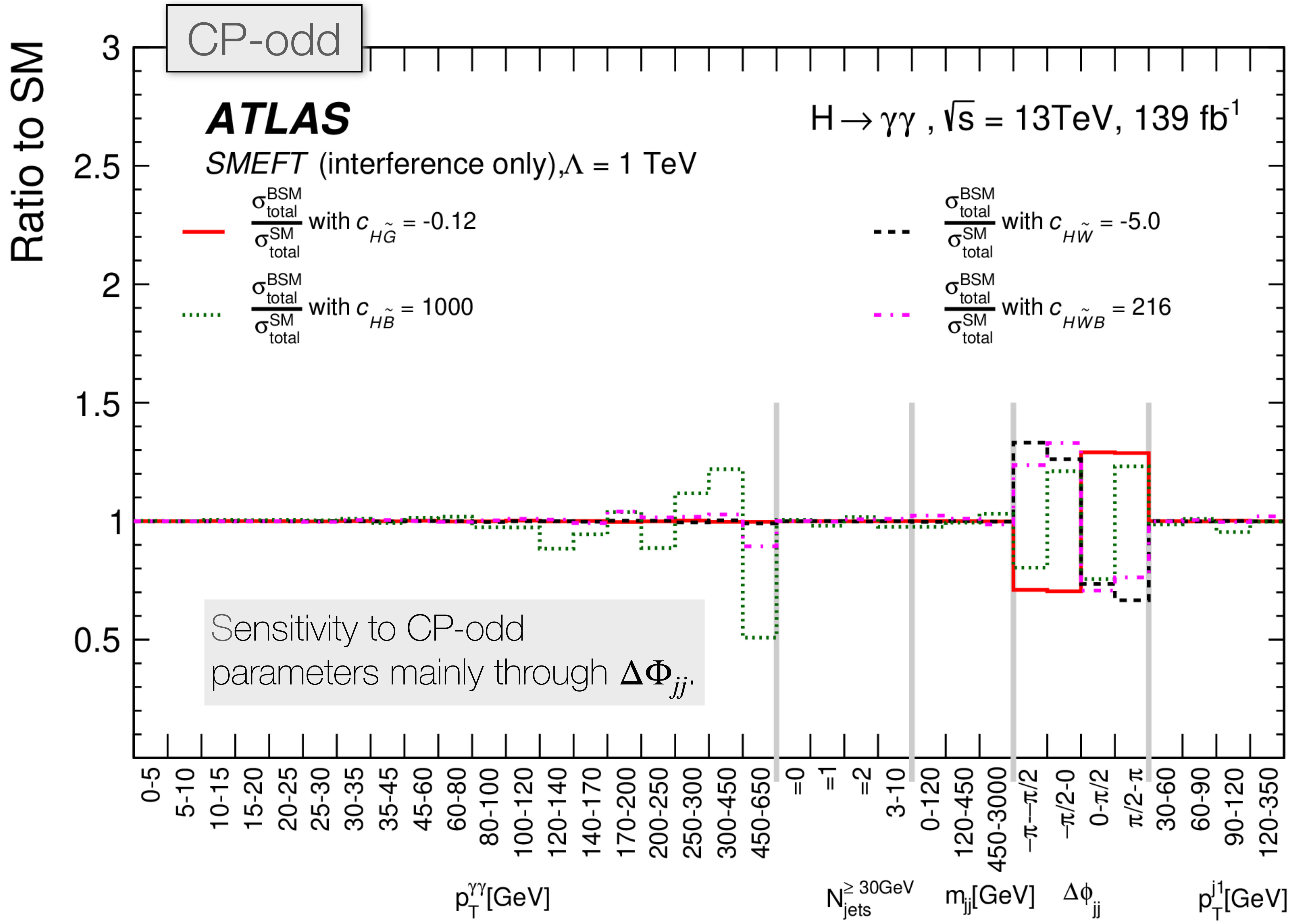
linear dim-6 terms   quadratic dim-6 terms   higher-dimension terms

Quadratic terms with $i \neq j$ not considered.

Using state-of-the-art SM predictions,
assuming there is no BSM impact on higher-order corrections.

Simultaneous fit to five differential distributions: $p_T^{\gamma\gamma}, N_{jets}, m_{jj}, \Delta\Phi_{jj}, p_T^{j1}$.





$H \to \gamma\gamma$ differential and fiducial cross sections in SMEFT

arXiv:2202.00487

SMEFT cross section parametrization: $\sigma B = (\sigma B)_{SM} \left(1 + \sum_i A_i^{(6)} \frac{C_i^{(6)}}{\Lambda^2} + \sum_{ij} B_{ij}^{(6)} \frac{C_i^{(6)} C_j^{(6)}}{\Lambda^4} + \ldots \right)$

Quadratic terms with $i \neq j$ not considered.

Using state-of-the-art SM predictions,
assuming there is no BSM impact on higher-order corrections.

linear dim-6 terms

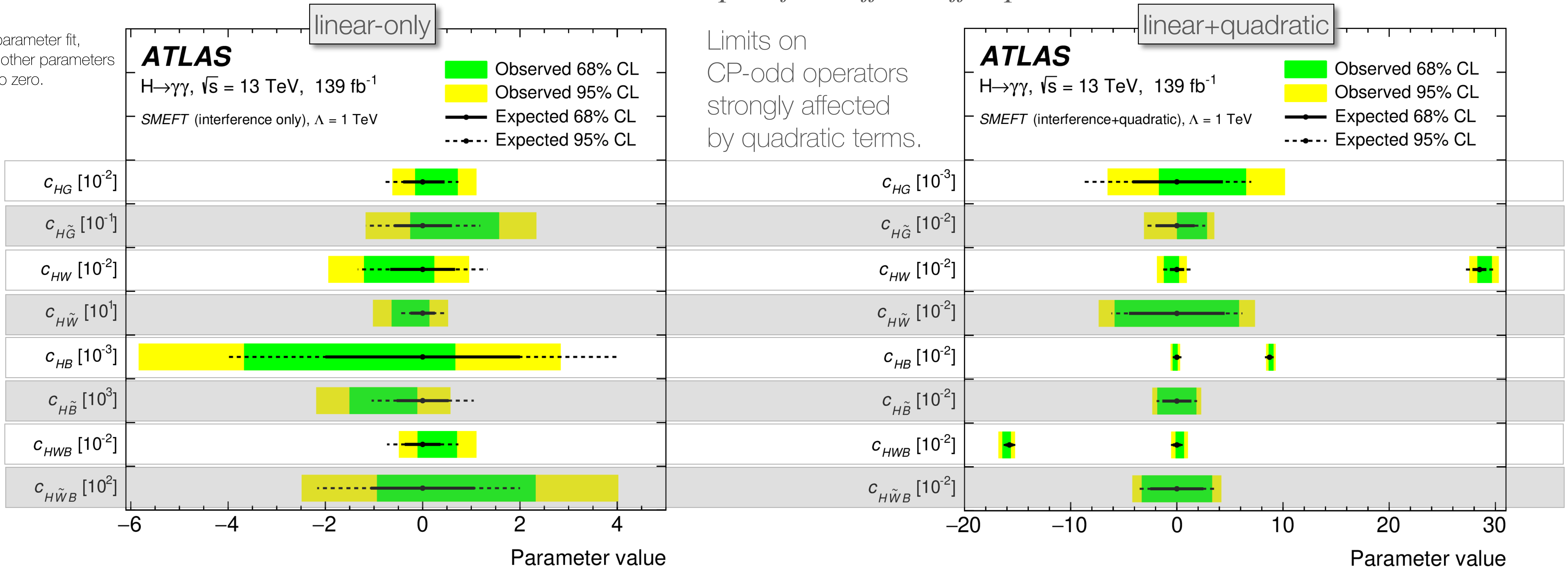
quadratic dim-6 terms

higher-dimension terms

Simultaneous fit to five differential distributions: $p_T^{\gamma\gamma}, N_{jets}, m_{jj}, \Delta\Phi_{jj}, p_T^{j1}$.

1D parameter fit, with other parameters set to zero.

Limits on CP-odd operators strongly affected by quadratic terms.



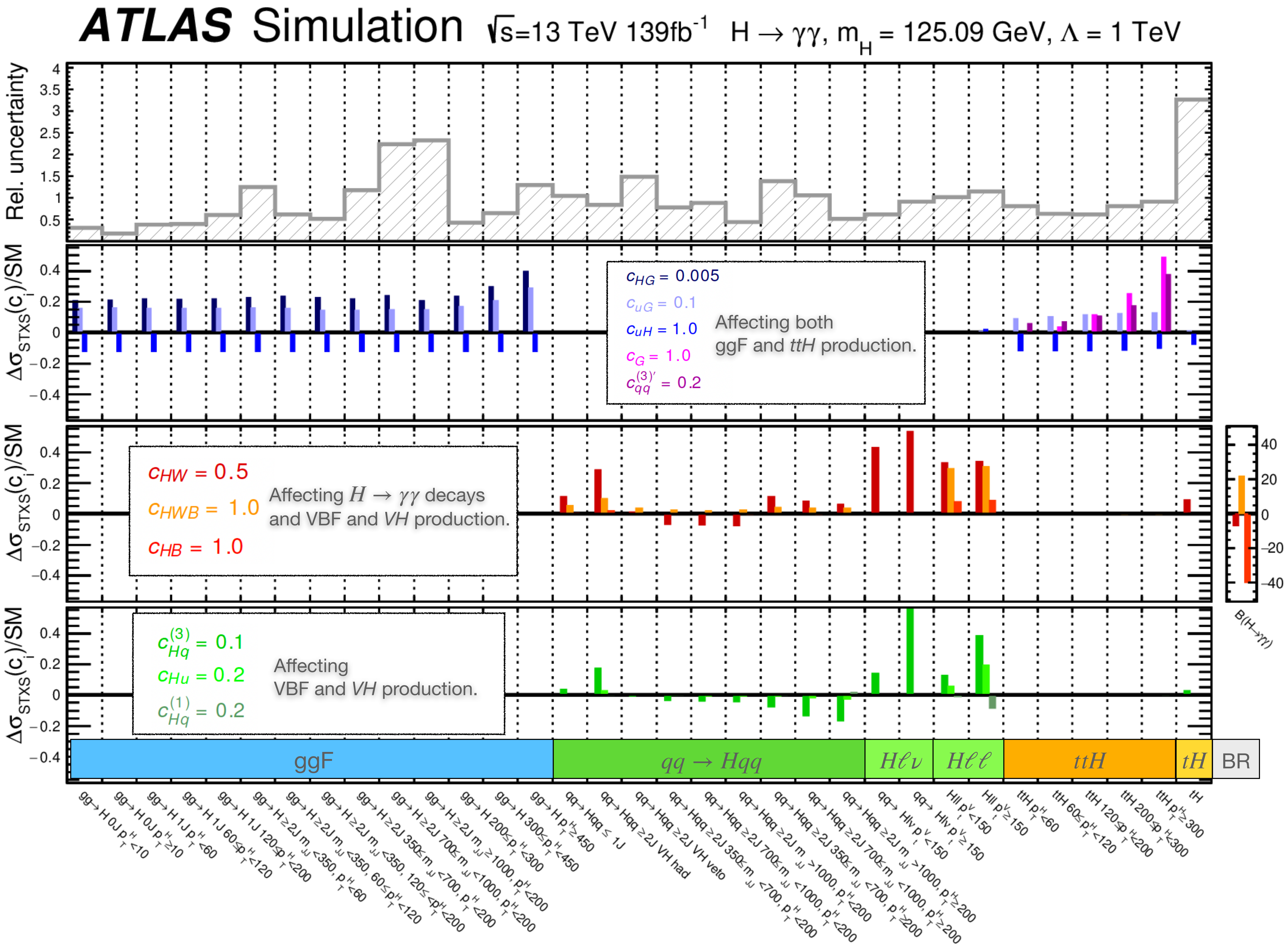
$H \to \gamma\gamma$ simplified template cross sections in SMEFT

arXiv:2207.00348

- Simplified Template Cross Sections **(STXS)**:

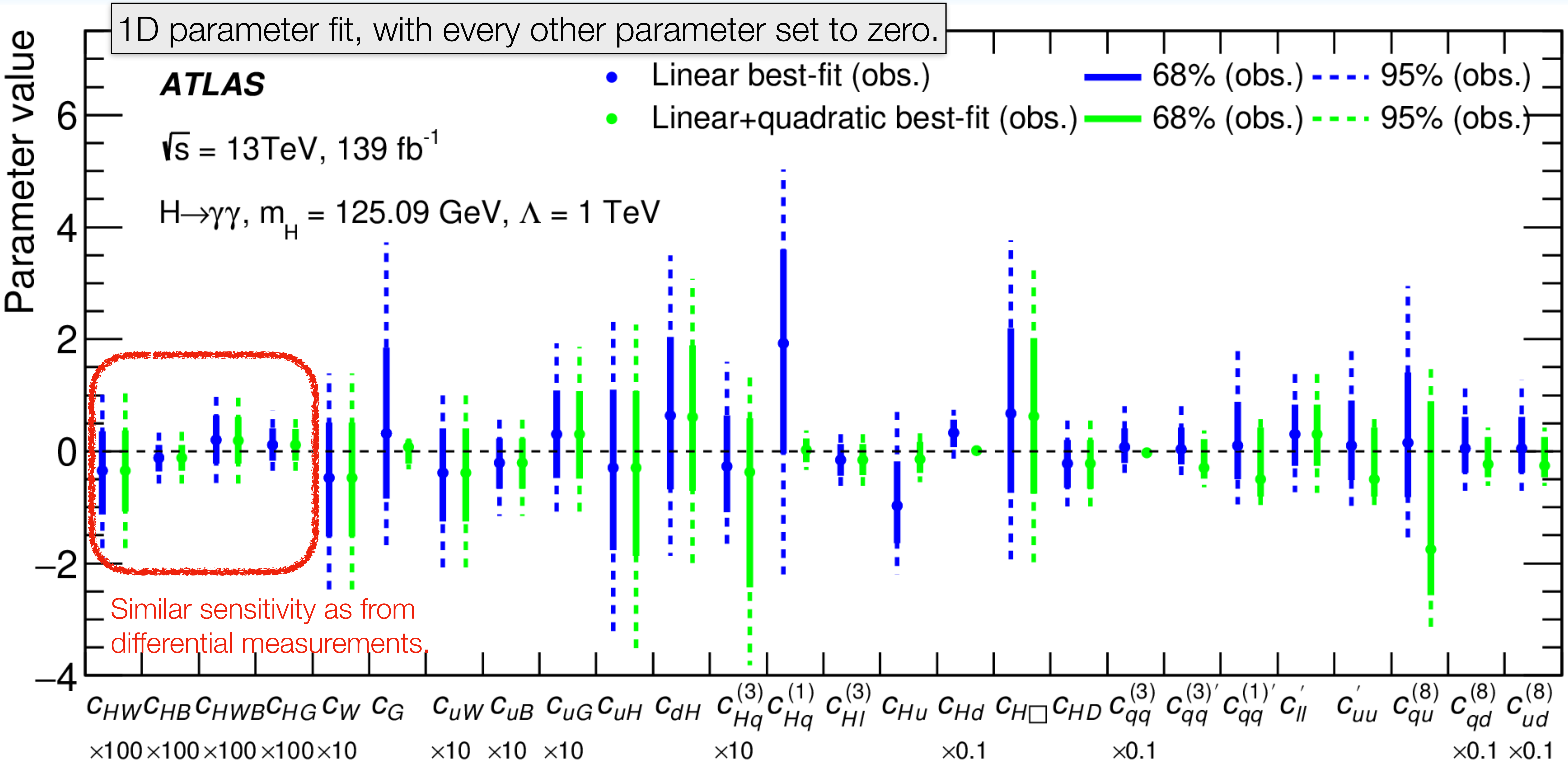
  Differential measurements with a coarser binning in p_T^H, N_{jets} and m_{jj}, but with additional information from different production vertices.

- Considering 34 Wilson coefficients with a visible impact.



$H \to \gamma\gamma$ simplified template cross sections in SMEFT

arXiv:2207.00348



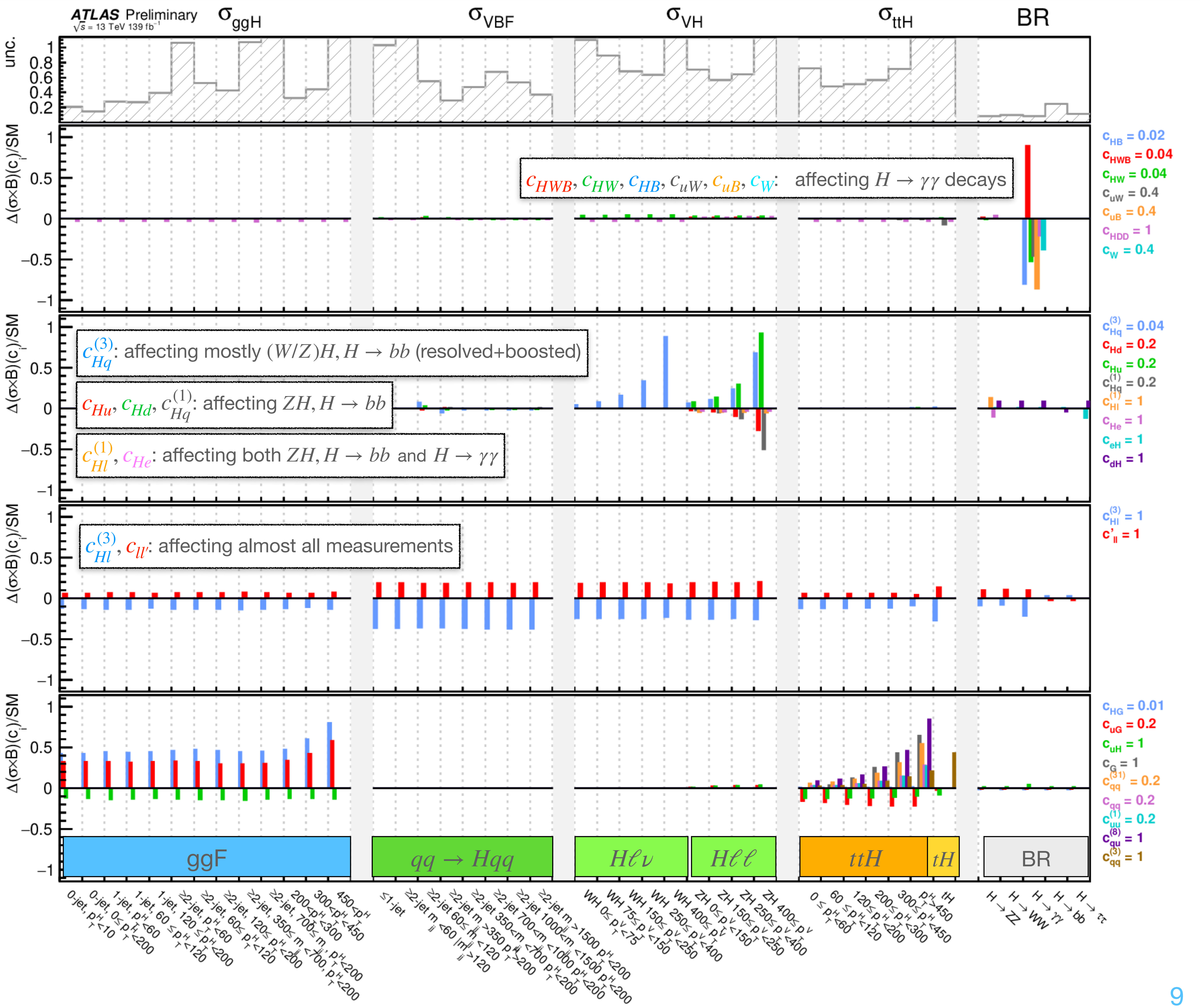
- Parameters affecting the high-pT bins (e.g. $c_G, c_{Hq}^{(1)}$ etc.) constrained predominantly by the quadratic terms, indicating non-negligible contributions from higher-order terms in the SMEFT expansion.
- 1D fits are a good measure of sensitivity, but don’t account for possible correlations between the Wilson coefficients.
  ➪ Simultaneous fit of 12 mutually orthogonal linear combinations of Wilson coefficients also performed.

Combined Higgs STXS measurements in SMEFT

ATLAS-CONF-2021-053

Decay channel	Targeted prod. modes	Ref.
$H \to \gamma\gamma$	ggF, VBF, WH, ZH, ttH,tH	[1]
$H \to ZZ^* \to 4\ell$	ggF, VBF, WH+ZH, ttH+tH	[2]
$H \to WW^* \to \ell\nu\ell\nu$	ggF, VBF	[3]
$H \to bb$	VBF, WH, ZH, ttH+tH	[4],[5],[6],[7]
$H \to \tau\tau$	ggF, VBF, WH, ZH, ttH+tH	[8]

Update of the previous combination using $\gamma\gamma$, 4ℓ and $VH(bb)$ inputs.



Combined Higgs STXS measurements in SMEFT

ATLAS-CONF-2021-053

Decay channel	Targeted prod. modes	Ref.
$H \to \gamma\gamma$	ggF, VBF, WH, ZH, ttH,tH	[1]
$H \to ZZ^* \to 4\ell$	ggF, VBF, WH+ZH, ttH+tH	[2]
$H \to WW^* \to \ell\nu\ell\nu$	ggF, VBF	[3]
$H \to bb$	VBF, WH, ZH, ttH+tH	[4],[5],[6],[7]
$H \to \tau\tau$	ggF, VBF, WH, ZH, ttH+tH	[8]

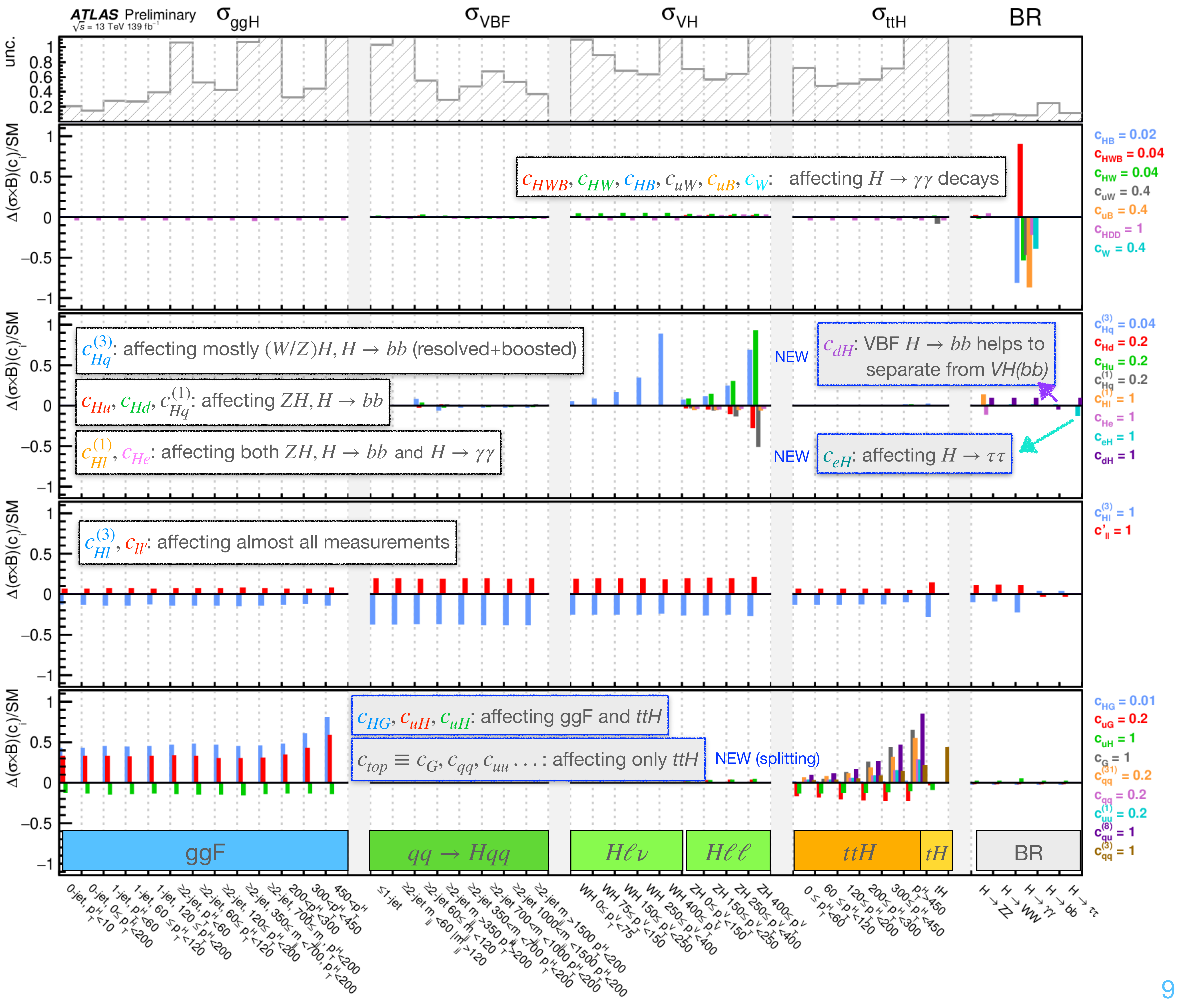
Update of the previous combination using $\gamma\gamma$, 4ℓ and $VH(bb)$ inputs.

- **Linear combinations of Wilson coefficients** along sensitive directions of parameter space: eigenvectors from principal component analysis of the Fischer information matrix

$$C^{-1}_{SMEFT} = P^T \, C^{-1}_{STXS} \, P.$$

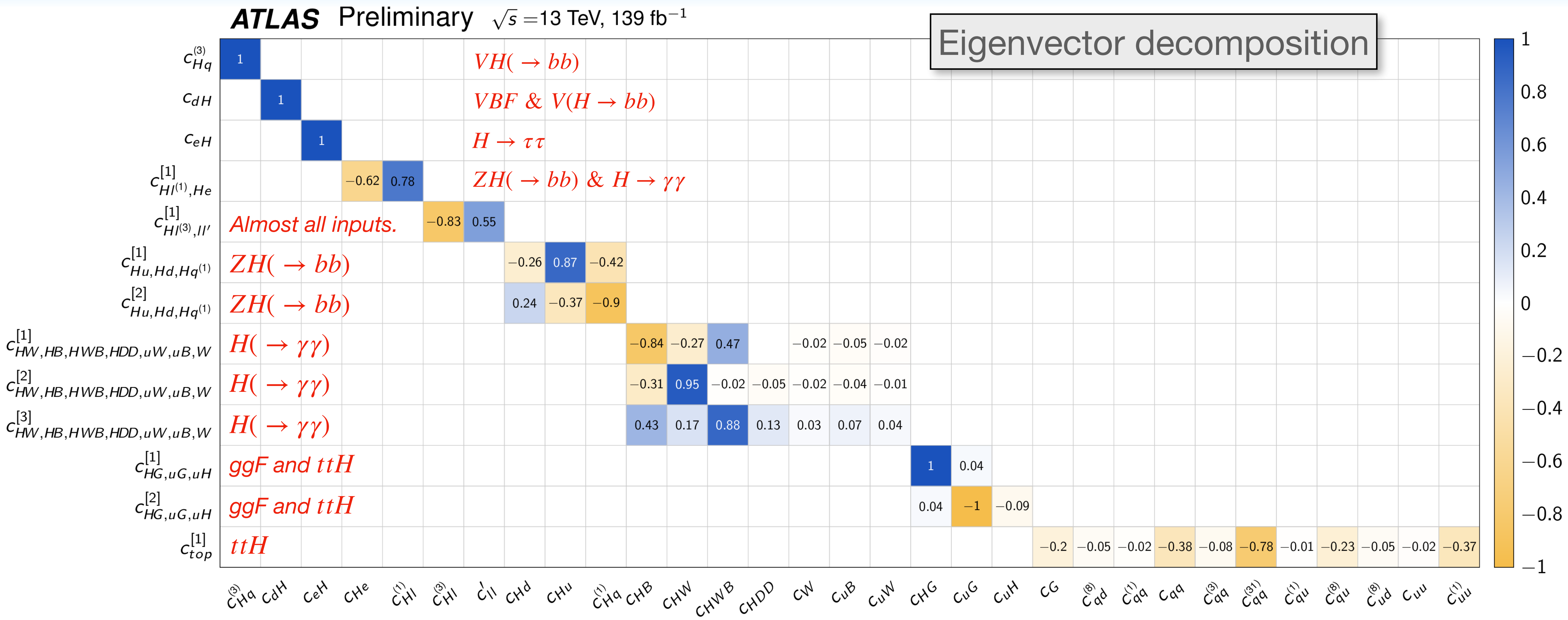
C^{-1}_{STXS} : STXS information matrix (Gaussian approx.)

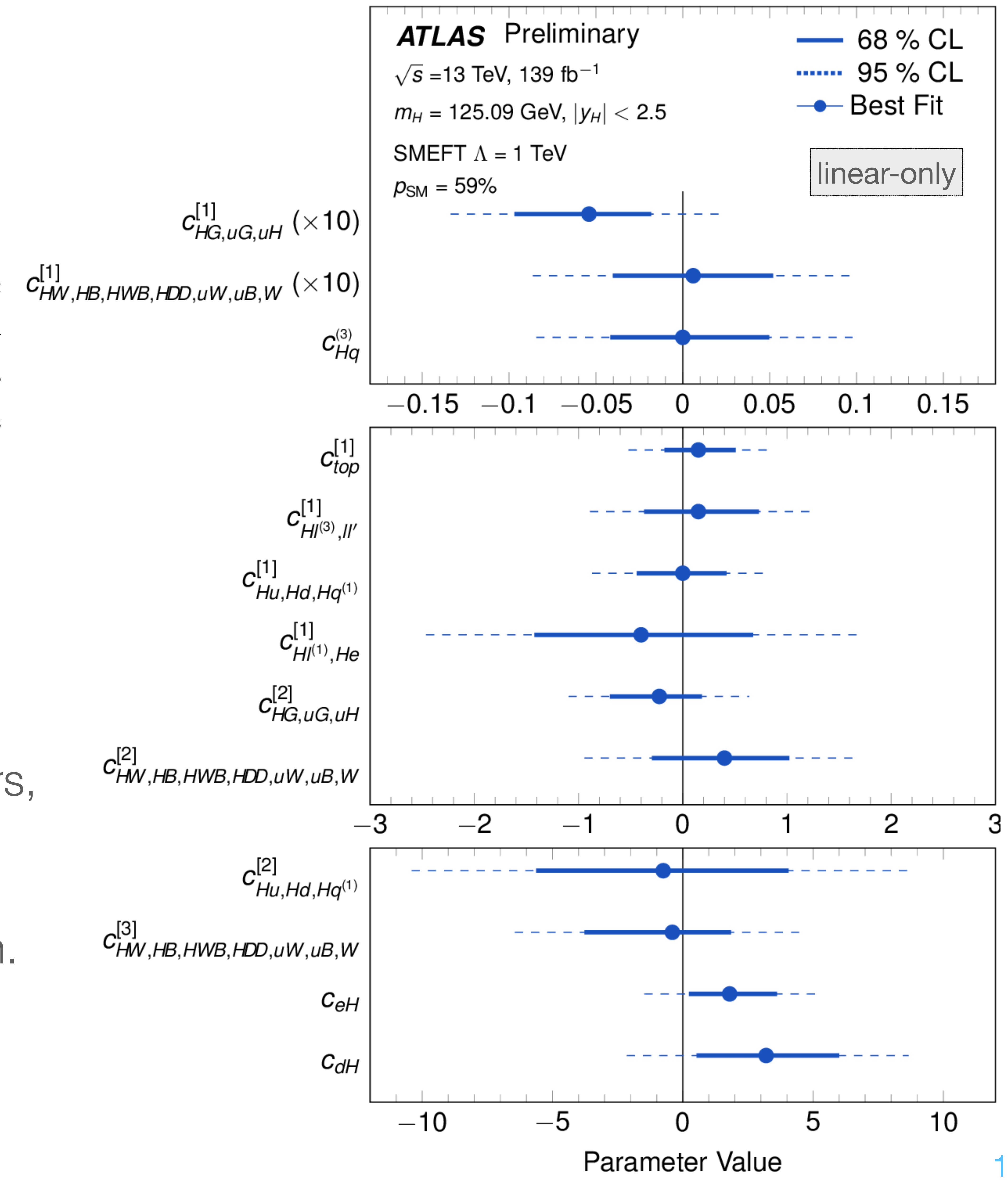
P : SMEFT parametrization matrix (linear-only)



Combined Higgs STXS measurements in SMEFT

ATLAS-CONF-2021-053





- Sensitivity to **3** Wilson coefficients directly ($c_{Hq}^{(3)}, c_{dH}, c_{eH}$) and to **10** linear combinations of other Wilson coefficients.
- c_{eH}, c_{dH} and $c_{top}^{[1]}$ for the first time disentangled from other parameters, due to the new inputs from $H \rightarrow \tau\tau, VBF\ H \rightarrow bb$ and $ttH(\rightarrow bb)$.
- Limits improve by up to 70% compared to the previous combination.
- Correlations in general significantly reduced.

Global SMEFT fit of Higgs+EW+EWPO data

ATL-PHYS-PUB-2022-037

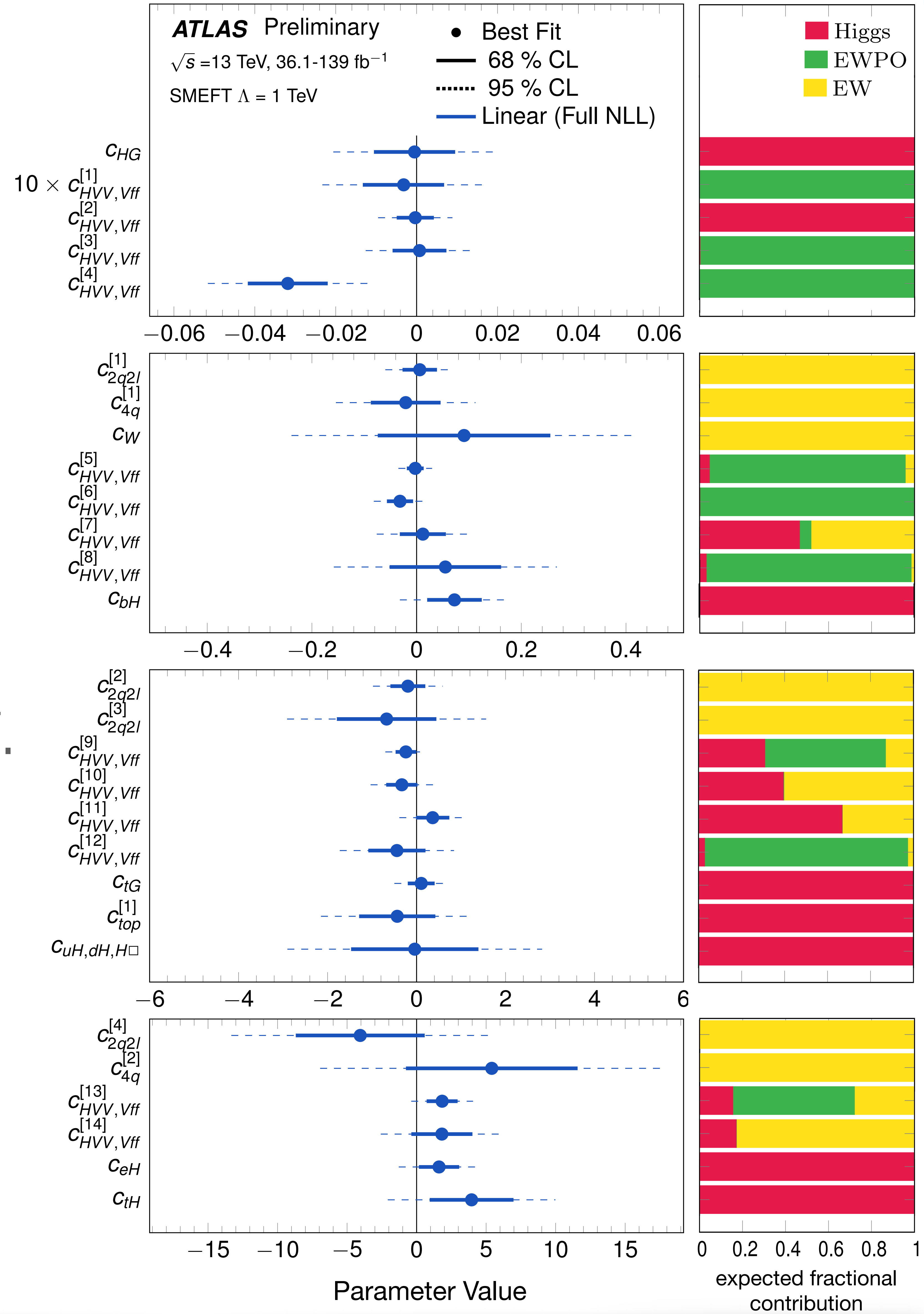
First global EFT interpretation in ATLAS:
(using $U(2)_q \times U(2)_u \times U(2)_d \times U(3)_l \times U(3)_e$) flavour symmetry)

- **Higgs STXS measurements**
- **EW differential distributions:**
  WW ($p_T^{\ell 1}$), WZ (m_{WZ}), 4l (m_{Z2}) and VBF Z ($\Delta\phi_{jj}$)
- **LEP/SLD EWPO:**
  $\Gamma_Z, R_\ell^0, R_c^0, R_b^0, A_{FB}^{0,\ell}, A_{FB}^{0,c}, A_{FB}^{0,b}, \sigma_{had}^0$

Constraining **6** individual and **22** linear combinations of Wilson coeff.

Five tightest constraints come mainly from a single observable:
$gg \rightarrow H$, σ_{had}^0, $H \rightarrow \gamma\gamma$, Γ_Z, A_{FB}.
Several constraints driven both by ATLAS and LEP/SLD.

Simplified likelihood model available for re-interpretations, provides results that are very similar to the full model.



For more details, see the talk by U. Blumenschein (Top and EW parallel session)

Summary

Increasing number of Higgs measurements interpreted in terms of Effective Field Theories.

Combined interpretation of simplified template cross section measurements well advanced.
- significantly increased number of sensitive directions
- straightforward implementation into a more global EFT fit

First global ATLAS EFT interpretation of Higgs, EW and EWPO data now available, providing also the corresponding simplified likelihood model.

Still a lot to do (on a global scale): treatment of truncation and higher-order uncertainties, addition of additional measurements to the combination, etc.

All results consistent with the SM predictions so far.

Backup Slides

Effective Field Theory: Motivation

Without any direct evidence of new physics beyond the SM so far,
the SM can be viewed as a low-energy approximation to a more fundamental theory.

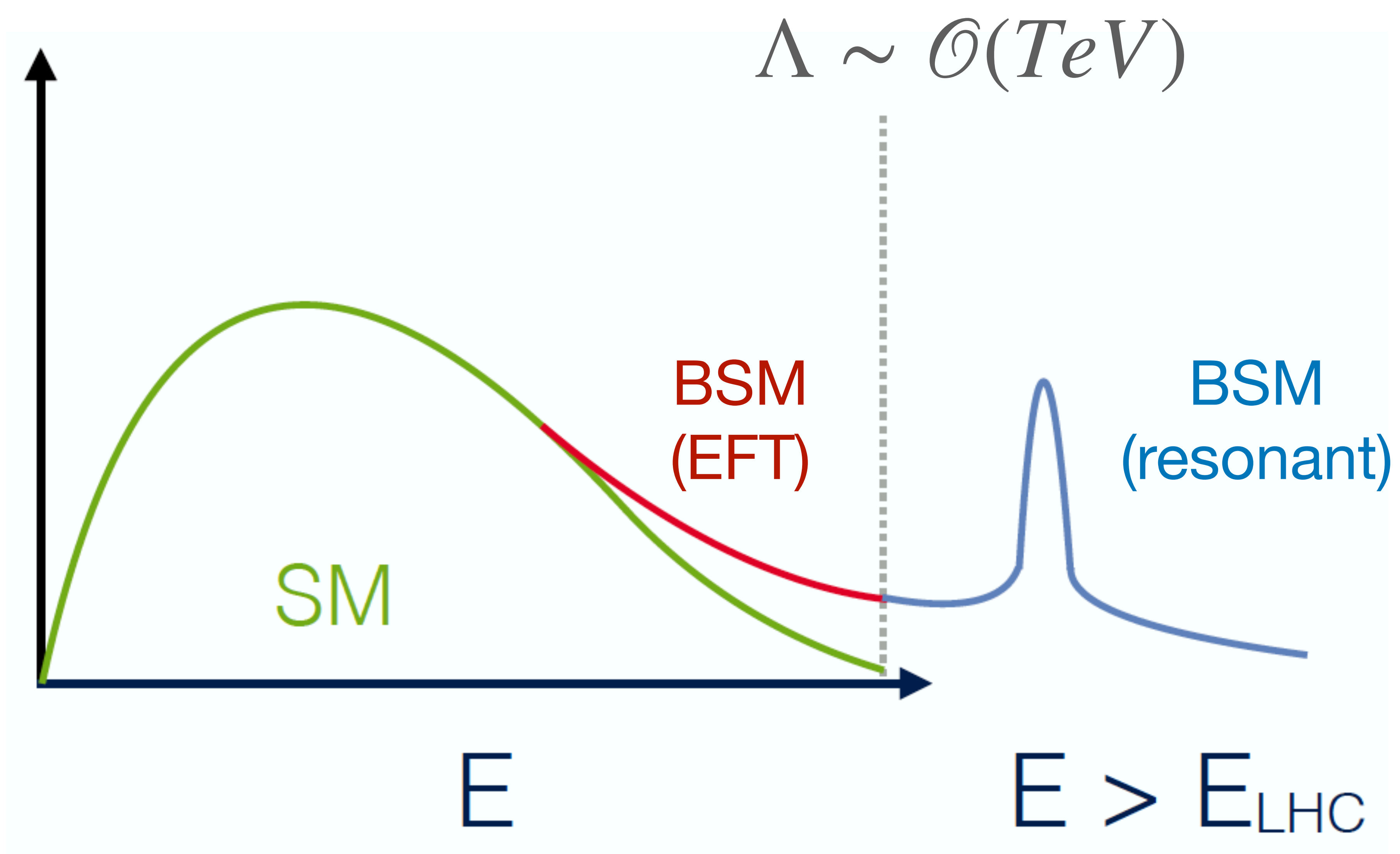
- Linearly realized SM Effective Field Theory (SMEFT):

  Assumes that the Higgs particle is part of a Higgs doublet.

$$\mathscr{L} = \mathscr{L}_{SM} + \sum_i \frac{C_i^{(d)}}{\Lambda^{d-4}} \mathcal{O}_i^{(d)}$$

Assuming
no lepton and baryon number violation:
first-order deviations come in general
from dimension-6 terms.

Deviations from the SM: higher-dimension operators $\mathcal{O}_i^{(d)}$,
suppressed by powers of Λ (mass scale of new physics).
Wilson coefficients $C_i^{(d)}$ are free parameters of the theory, correlated to each other.



- Non-linearly realized Higgs Effective Field Theory (HEFT):

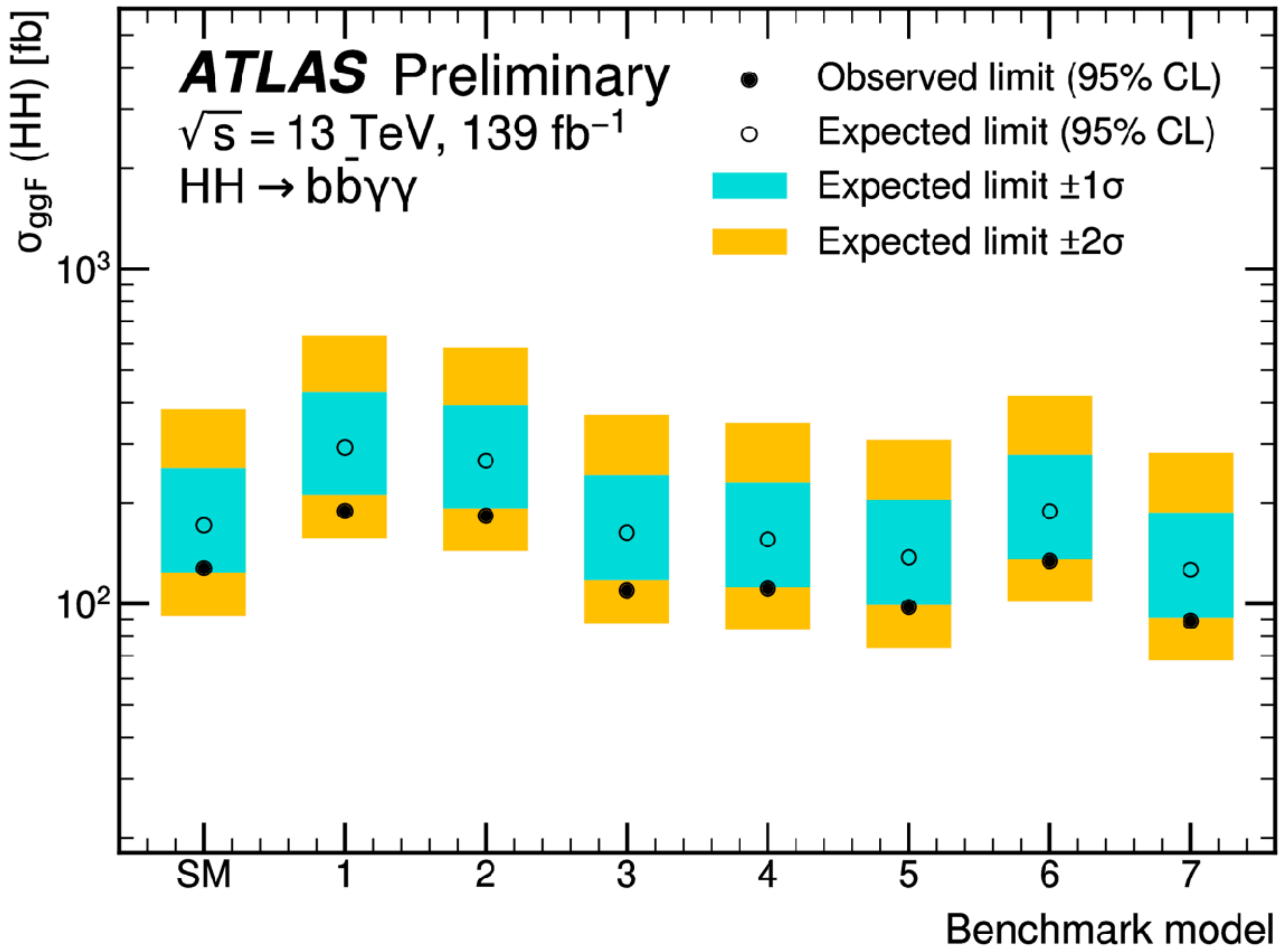
  Higgs and EW Goldstone bosons are treated independently, Higgs is assigned to a singlet representation.

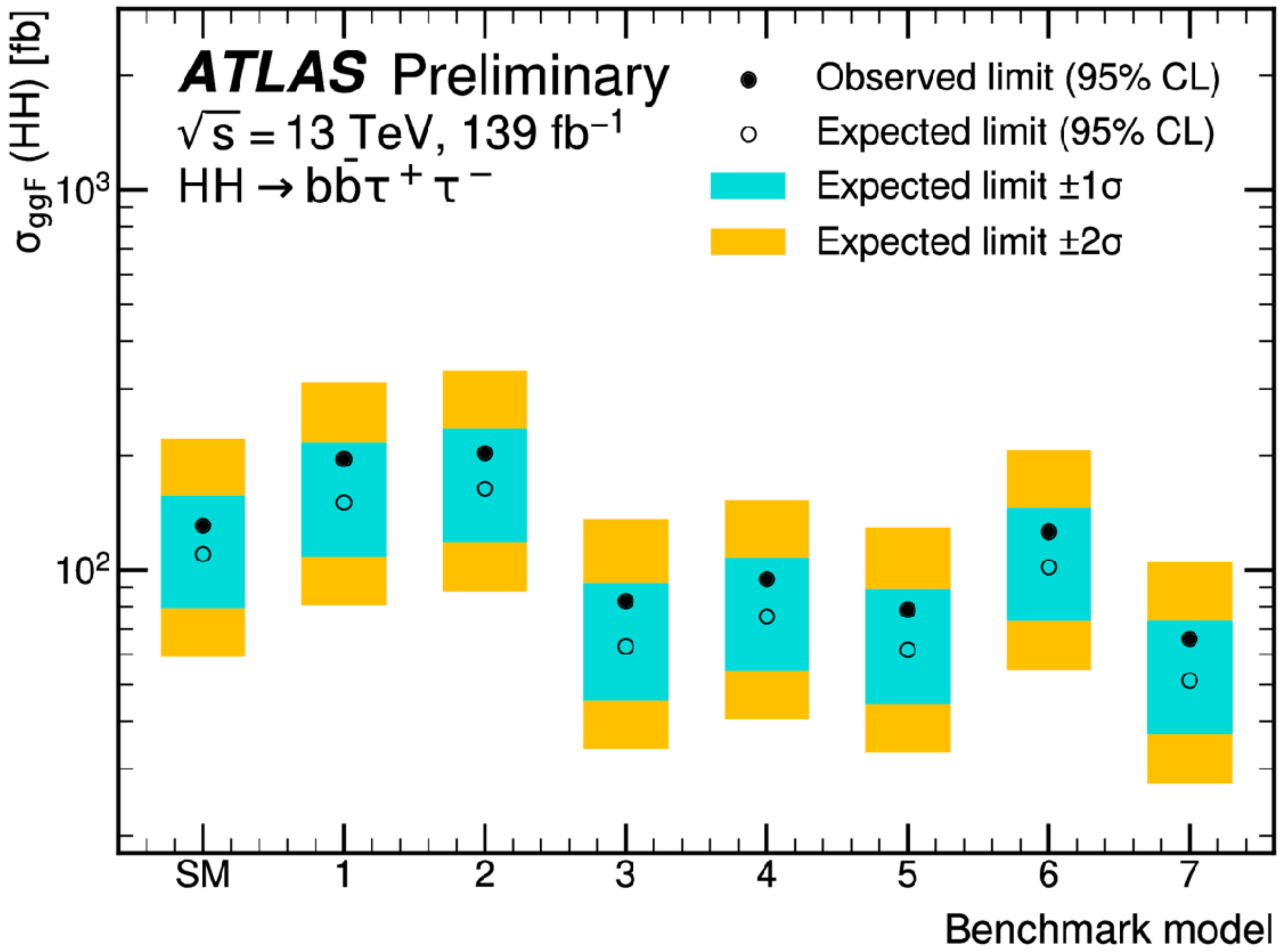
  More general framework, encompassing SMEFT. Free parameters of the theory are not correlated.

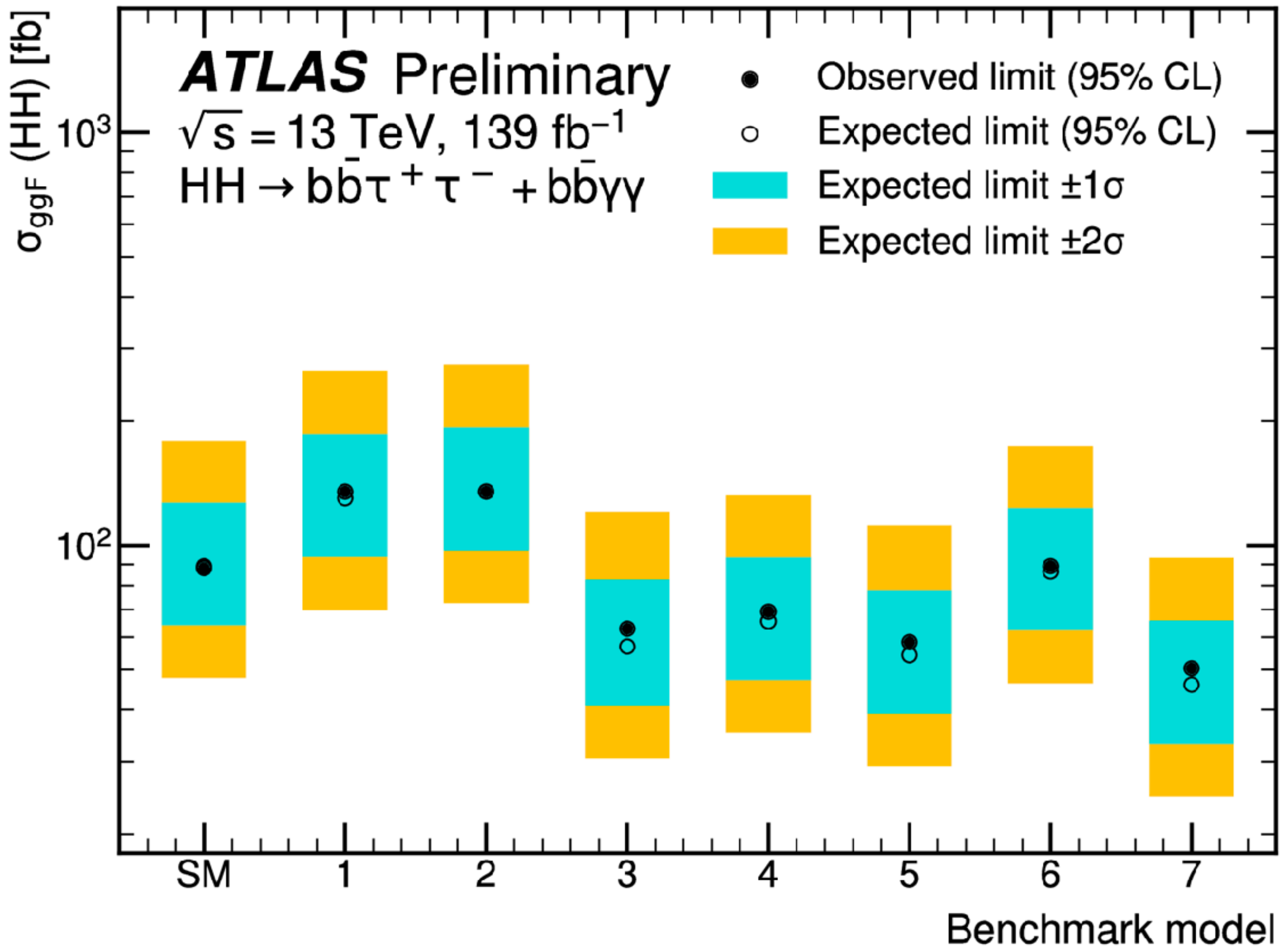
HEFT interpretation of Higgs pair search

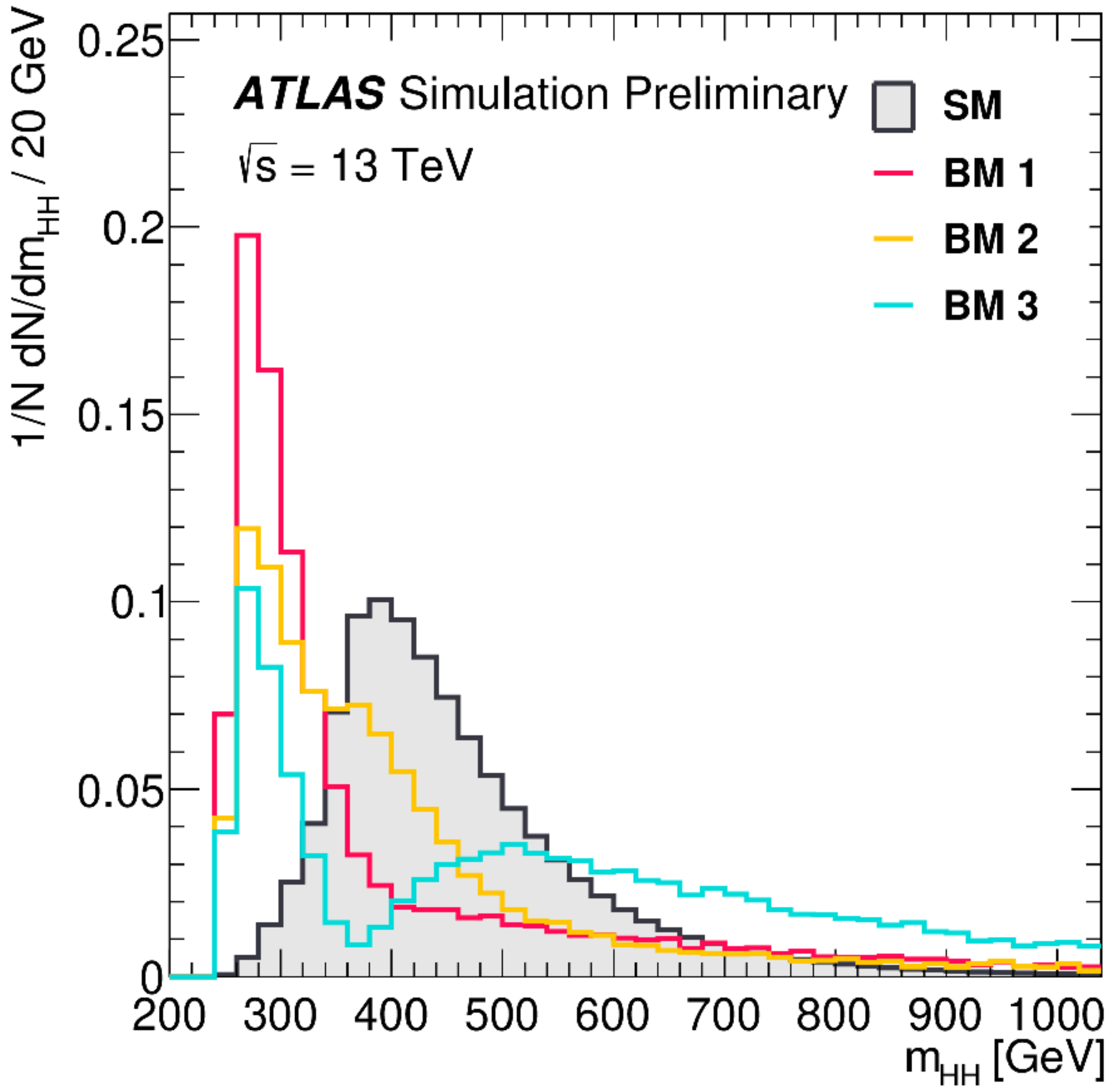
ATLAS-PHYS-PUB-2022-019

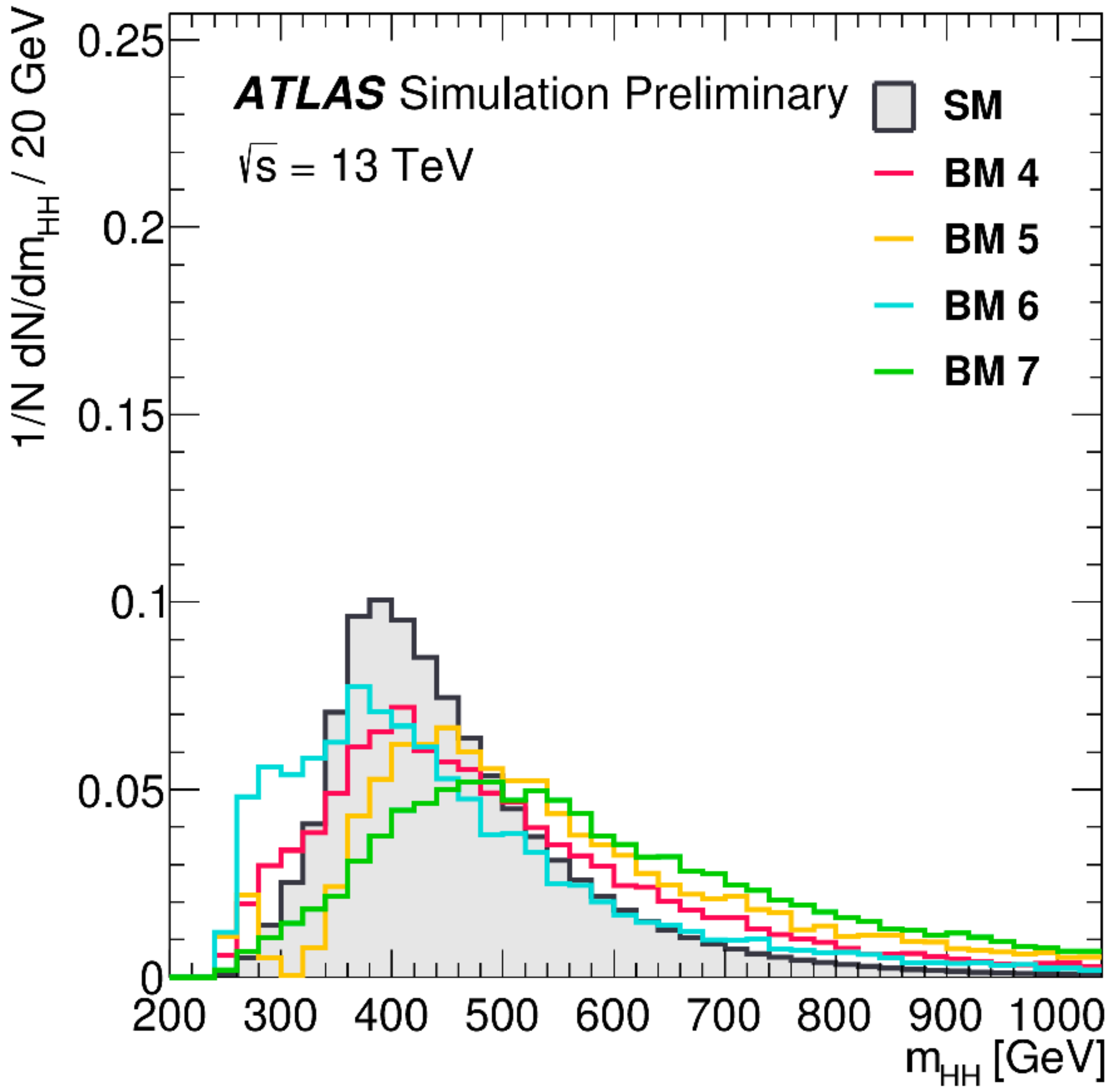
HEFT signal modeled using the m_{HH} reweighing procedure. Buchalla et al, JHEP 09 (2018) 057











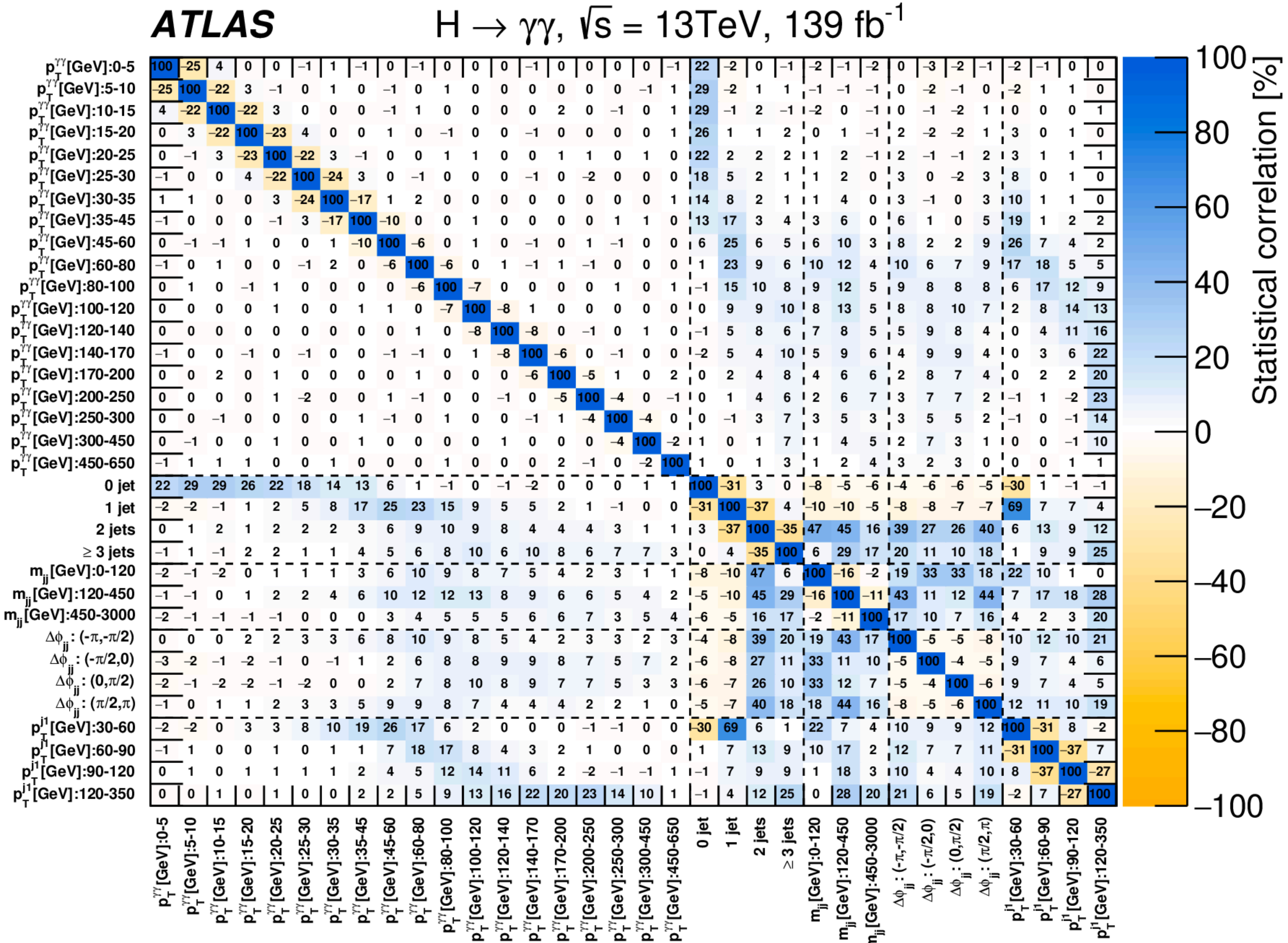
Benchmark model	c_{hhh}	c_{tth}	c_{ggh}	c_{gghh}	c_{tthh}
SM	1	1	0	0	0
BM 1	3.94	0.94	1/2	1/3	−1/3
BM 2	6.84	0.61	0.0	−1/3	1/3
BM 3	2.21	1.05	1/2	1/2	−1/3
BM 4	2.79	0.61	−1/2	1/6	1/3
BM 5	3.95	1.17	1/6	−1/2	−1/3
BM 6	5.68	0.83	−1/2	1/3	1/3
BM 7	−0.10	0.94	1/6	−1/6	1

Wilson coefficient	$b\bar{b}\gamma\gamma$ Obs.	$b\bar{b}\gamma\gamma$ Exp.	$b\bar{b}\tau^+\tau^-$ Obs.	$b\bar{b}\tau^+\tau^-$ Exp.	Combination Obs.	Combination Exp.
c_{gghh}	$[-0.4, 0.5]$	$[-0.5, 0.7]$	$[-0.4, 0.4]$	$[-0.4, 0.4]$	$[-0.3, 0.4]$	$[-0.3, 0.3]$
c_{tthh}	$[-0.3, 0.8]$	$[-0.4, 0.9]$	$[-0.3, 0.7]$	$[-0.2, 0.6]$	$[-0.2, 0.6]$	$[-0.2, 0.6]$

$H \rightarrow \gamma\gamma$ differential and fiducial cross sections in SMEFT

arXiv:2202.00487

Observed statistical correlations, evaluated with bootstrapping technique, between $p_T^{\gamma\gamma}, N_{jets}, m_{jj}, \Delta\Phi_{jj}, p_T^{j1}$.



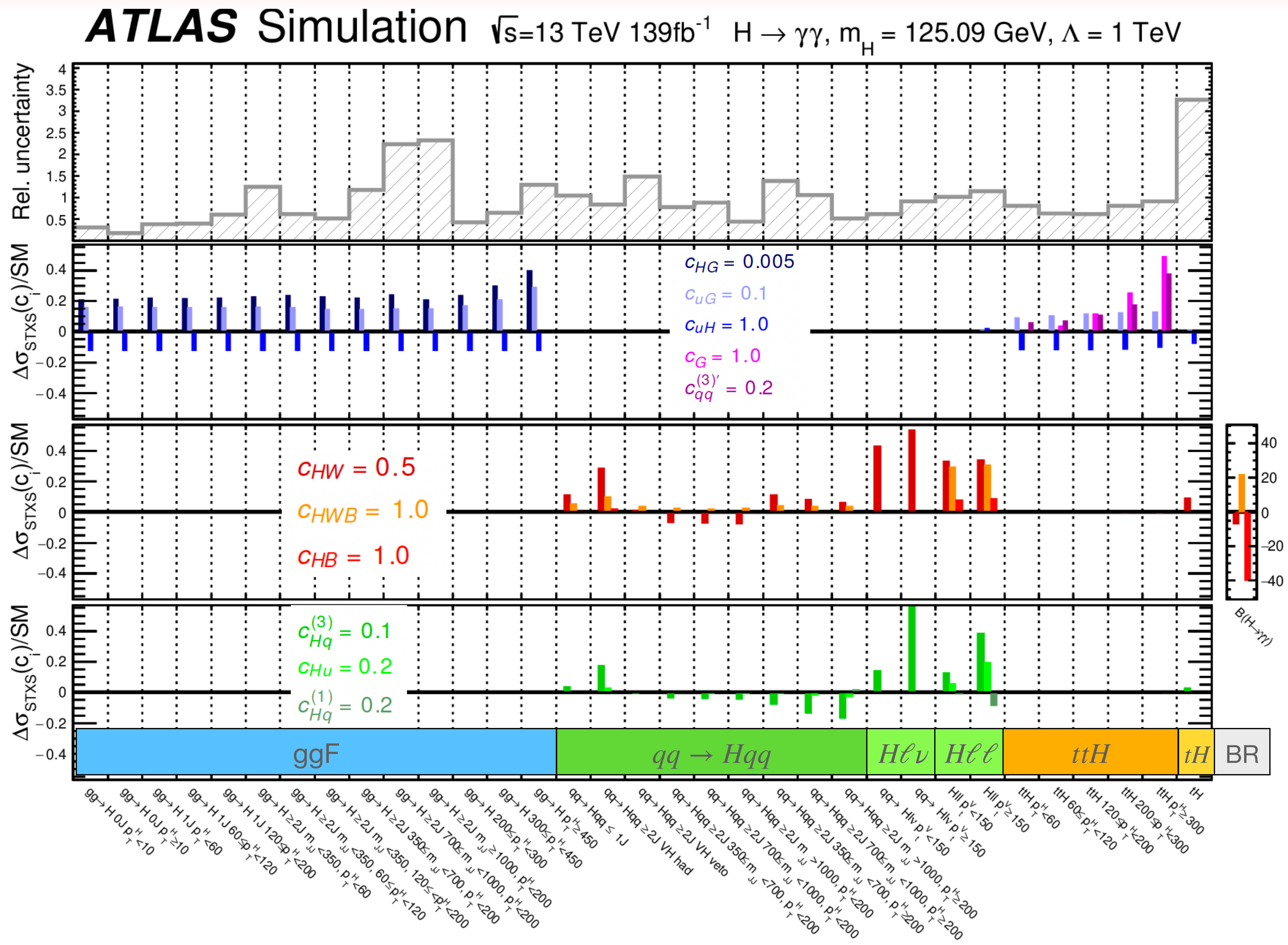
$H \to \gamma\gamma$ differential and fiducial cross sections in SMEFT

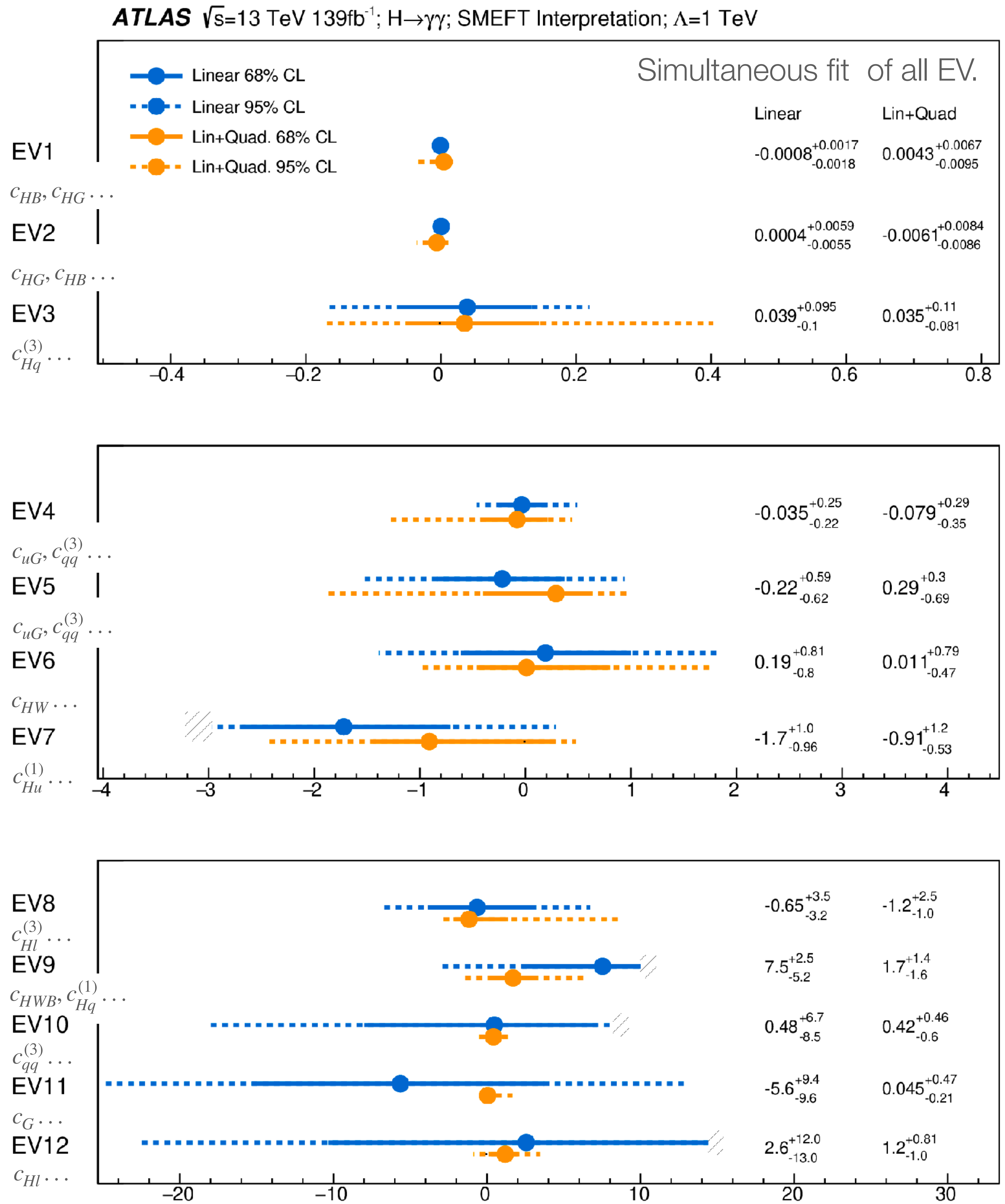
arXiv:2202.00487

2D constraints on Wilson coefficients:

$H \to \gamma\gamma$ simplified template cross sections in SMEFT

arXiv:2207.00348





- 33 Wilson coefficients considered in total.
- Linear combinations of coefficients (EV) along sensitive directions determined using principal component analysis (ATLAS-CONF-2020-053).

$H \to \gamma\gamma$ simplified template cross sections in SMEFT

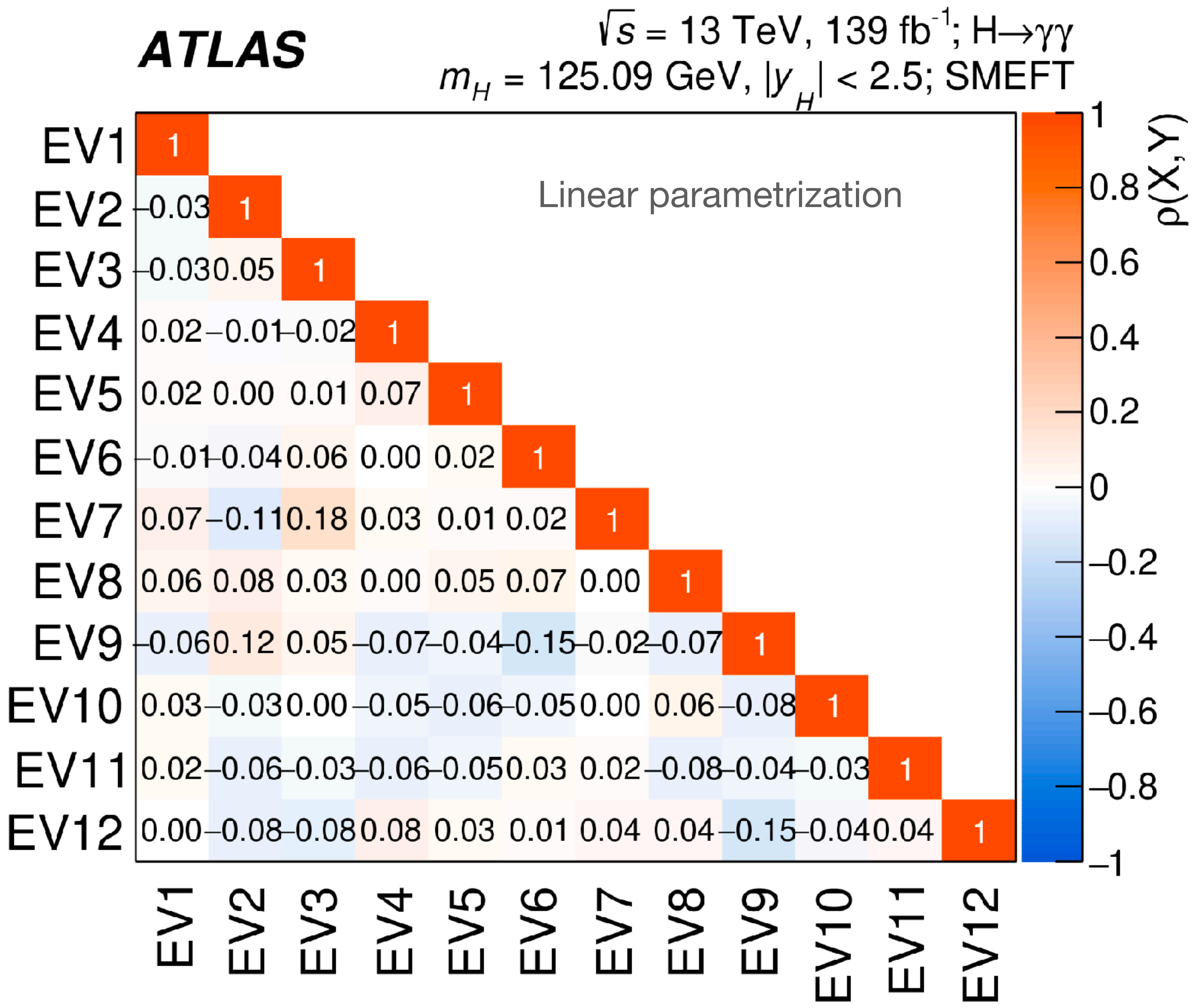
arXiv:2207.00348

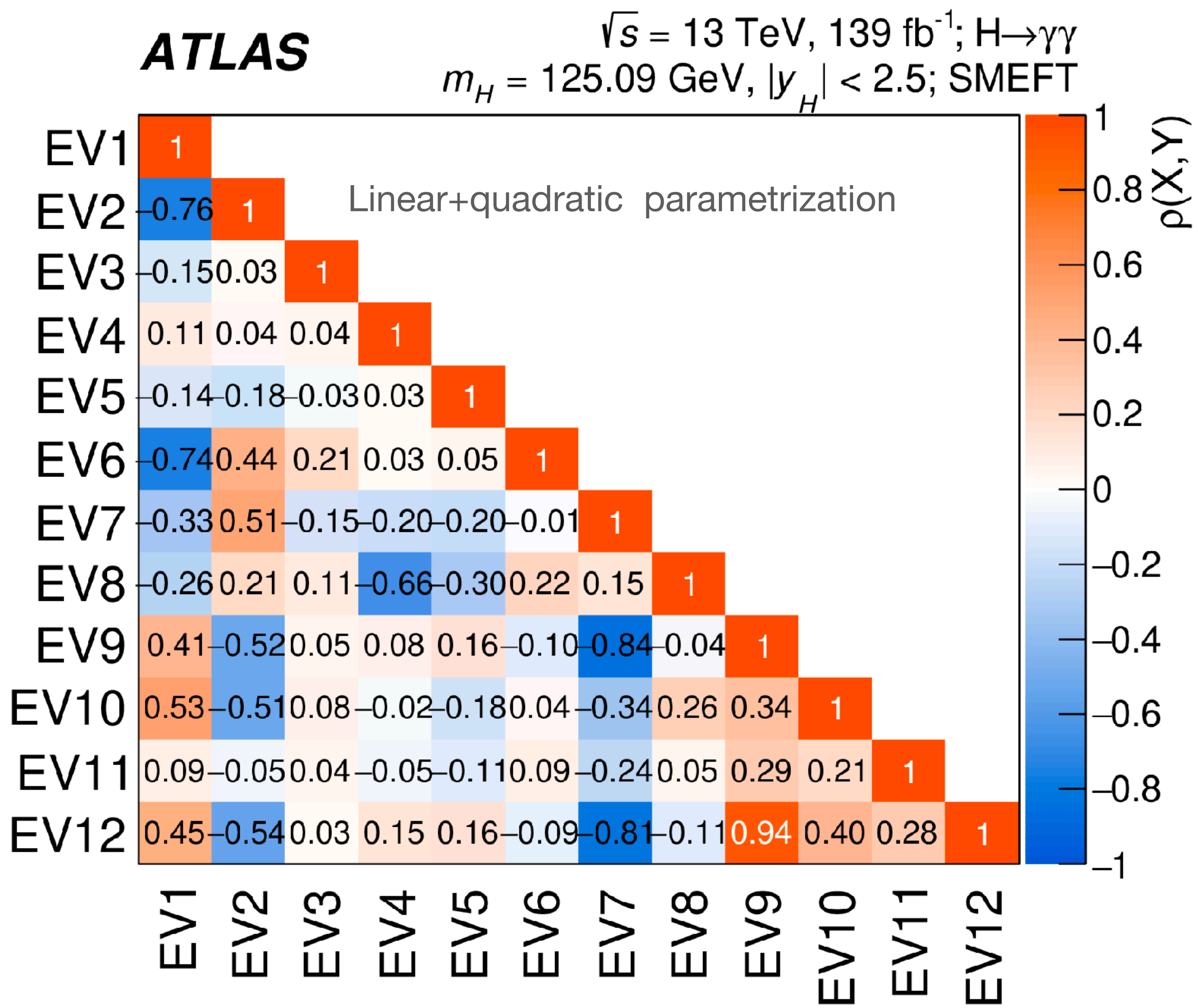
ATLAS $\sqrt{s}$=13 TeV 139fb^{-1}; $H\to\gamma\gamma$

	C_{HG}	C_{uG}	C_{uH}	C_{HW}	C_{HB}	C_{HWB}	C_{W}	C_{uW}	C_{uB}	$C_{Hl}^{(3)}$	C'_{ll}	C_{HDD}	C_{Hbox}	$C_{Hq}^{(3)}$	C_{Hu}	C_{Hd}	$C_{Hq}^{(1)}$	C_{He}	$C_{Hl}^{(1)}$	C_{G}	$C_{qq}^{(1)}$	$C_{qq}^{(1)'}$	$C_{qq}^{(3)}$	$C_{qq}^{(3)'}$	C_{uu}	C'_{uu}	$C_{ud}^{(8)}$	$C_{qu}^{(1)}$	$C_{qu}^{(8)}$	$C_{qd}^{(8)}$	$C_{ud}^{(1)}$	C_{eH}	C_{dH}	
EV12	-0.00	-0.01	-0.15	0.01	-0.20	-0.36	-0.00	0.02	-0.01	-0.13	-0.16	-0.06	0.00	-0.00	0.37	-0.30	0.69	0.10	0.14	0.14	0.00	-0.02	-0.05	-0.01	0.00	-0.02	0.00	0.00	-0.01	-0.00	-0.00	0.00	0.00	λ =0.0067
EV11	0.00	-0.01	0.04	0.01	-0.03	-0.05	-0.00	-0.02	0.00	-0.10	0.03	-0.00	0.00	0.00	0.06	-0.05	0.11	0.01	0.02	-0.95	-0.00	0.15	0.05	0.11	-0.01	0.13	-0.01	-0.01	0.09	-0.00	0.00	-0.00	0.00	λ =0.0108
EV10	-0.00	-0.00	0.06	0.02	-0.09	-0.13	-0.00	0.37	-0.00	0.05	-0.02	-0.00	0.00	-0.00	0.01	0.02	-0.14	0.02	0.03	-0.05	0.00	0.04	-0.89	0.06	0.00	0.03	0.00	-0.00	0.02	0.00	0.00	0.00	0.00	λ =0.027
EV9	-0.00	0.01	0.03	0.09	-0.38	-0.65	-0.00	-0.08	-0.01	-0.17	0.03	-0.08	0.00	-0.02	0.13	0.04	-0.56	0.09	0.12	0.02	-0.00	-0.01	0.18	-0.02	-0.00	-0.01	-0.00	-0.00	-0.01	-0.00	-0.00	-0.00	0.00	λ =0.038
EV8	-0.00	0.27	0.38	0.02	0.06	0.10	0.00	0.02	0.00	-0.78	0.37	0.07	-0.00	0.01	-0.04	0.00	0.09	0.00	0.00	0.09	-0.00	-0.03	-0.06	-0.04	0.00	-0.03	0.00	0.00	-0.02	-0.00	-0.00	-0.00	-0.00	λ =0.075
EV7	-0.00	0.03	0.03	0.09	0.15	0.32	0.00	0.00	0.00	0.02	0.01	0.05	0.00	-0.10	0.83	-0.25	-0.31	-0.04	-0.05	0.00	0.00	0.00	-0.01	0.00	0.00	0.00	-0.00	0.00	0.00	-0.00	-0.00	-0.00	0.00	λ =0.89
EV6	0.01	-0.24	0.01	-0.90	0.21	-0.14	0.01	0.01	0.01	-0.11	0.01	0.01	-0.00	0.15	0.10	-0.03	-0.08	0.00	0.01	0.03	0.00	0.05	0.00	0.08	0.00	0.05	0.00	0.00	0.03	0.00	-0.00	-0.00	-0.00	λ =1.78
EV5	-0.02	0.64	-0.09	-0.24	0.04	-0.06	0.00	0.00	0.00	0.15	-0.09	-0.01	-0.00	0.05	0.02	-0.01	-0.02	0.00	0.00	-0.19	-0.02	-0.28	-0.04	-0.52	-0.01	-0.27	-0.03	-0.01	-0.16	-0.03	0.00	-0.00	-0.00	λ =2.87
EV4	-0.01	0.68	-0.06	-0.08	0.01	-0.04	0.00	-0.01	-0.00	0.13	-0.07	-0.01	0.00	0.08	0.00	-0.00	-0.01	0.00	0.00	0.14	0.01	0.27	0.06	0.56	0.02	0.26	0.04	0.01	0.17	0.04	-0.00	-0.00	0.00	λ =20.2
EV3	-0.01	0.05	-0.01	-0.17	0.03	-0.04	0.00	0.00	0.00	-0.01	-0.01	0.00	-0.00	-0.98	-0.07	0.02	0.03	0.00	0.00	0.01	0.00	0.01	0.00	0.03	0.00	0.01	0.00	0.00	0.01	0.00	-0.00	0.00	-0.00	λ =106
EV2	-0.85	-0.02	0.00	-0.14	-0.44	0.25	-0.01	-0.01	-0.02	-0.01	0.00	-0.00	0.00	0.01	0.00	-0.00	-0.00	-0.00	-0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	-0.00	0.00	0.00	λ =34473
EV1	-0.53	-0.02	0.00	0.23	0.71	-0.40	0.02	0.02	0.04	0.01	-0.00	0.00	-0.00	-0.00	-0.00	0.00	0.00	-0.00	-0.00	-0.00	0.00	-0.00	-0.00	-0.00	0.00	-0.00	-0.00	0.00	-0.00	-0.00	-0.00	-0.00	-0.00	λ =346827

$H \to \gamma\gamma$ simplified template cross sections in SMEFT

arXiv:2207.00348





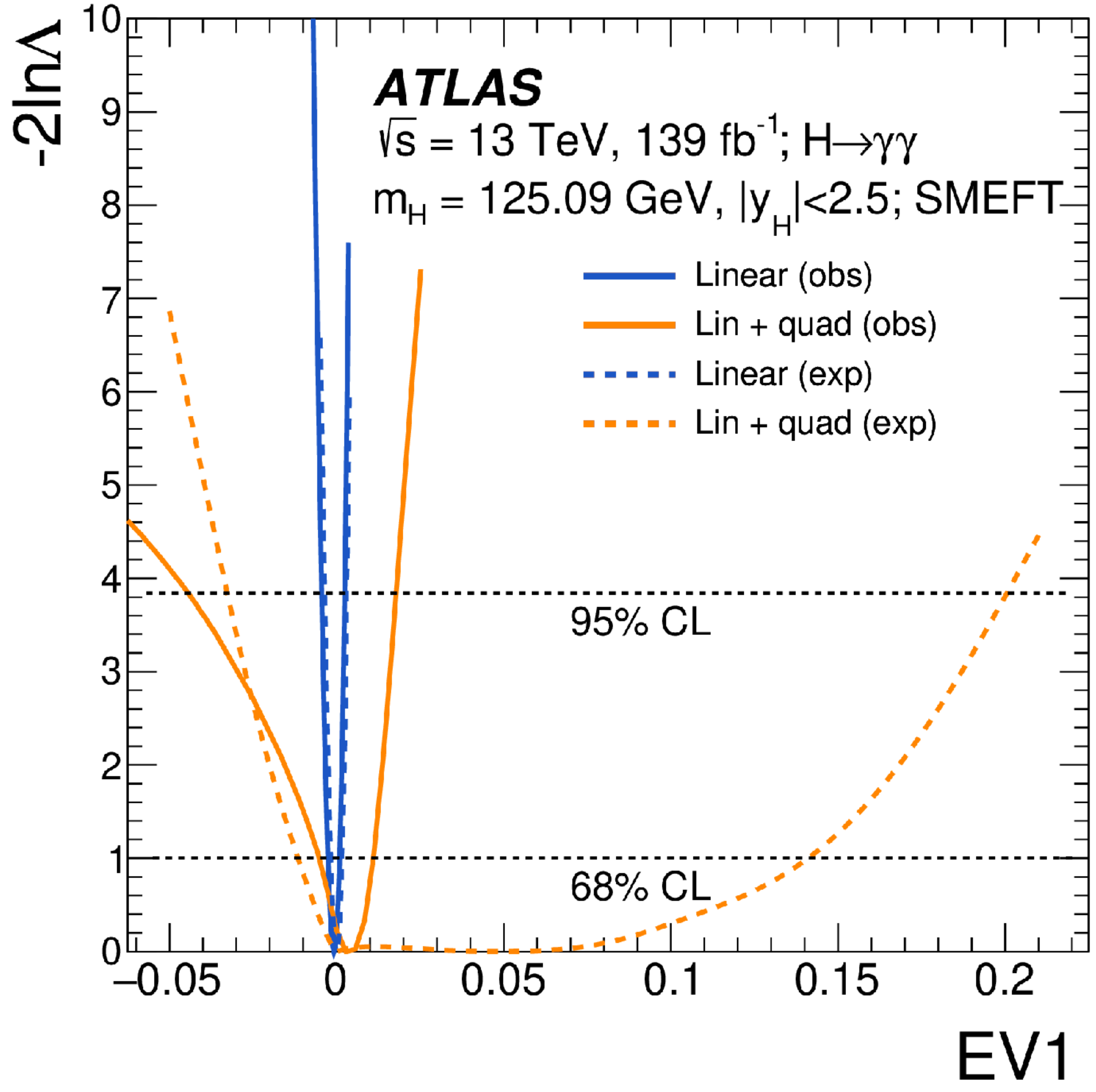
Non-zero values outside the diagonal: information matrix used in the PCA is not an exact representation of the measurement.

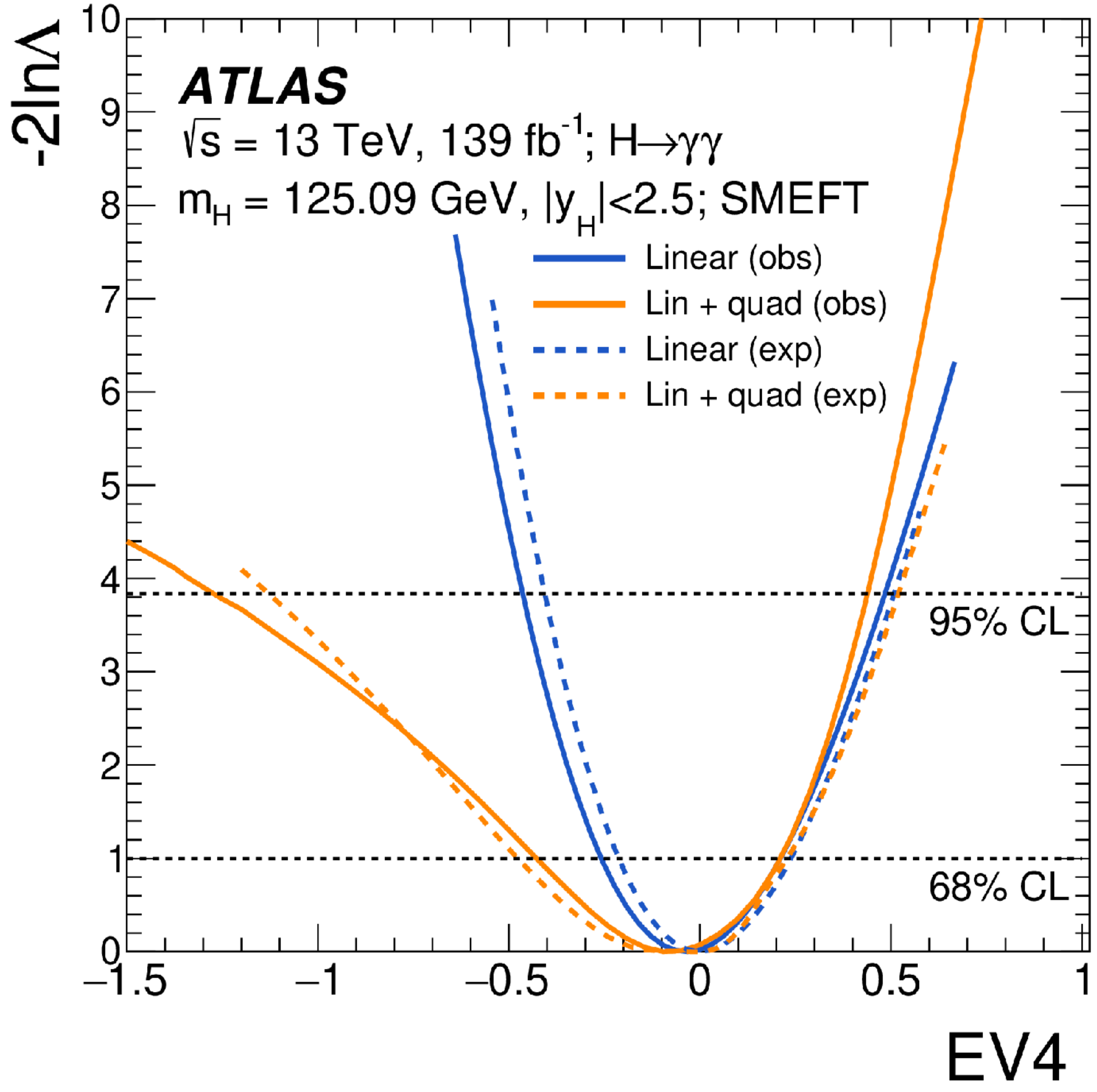
Larger correlations observed due to the effect of the quadratic terms, which are not considered in the PCA.

Differences not considered in PCA:
non-Gaussian effects due to low event counts in some categories and the non-linear impact of some systematic uncertainties.

$H \to \gamma\gamma$ simplified template cross sections in SMEFT

arXiv:2207.00348





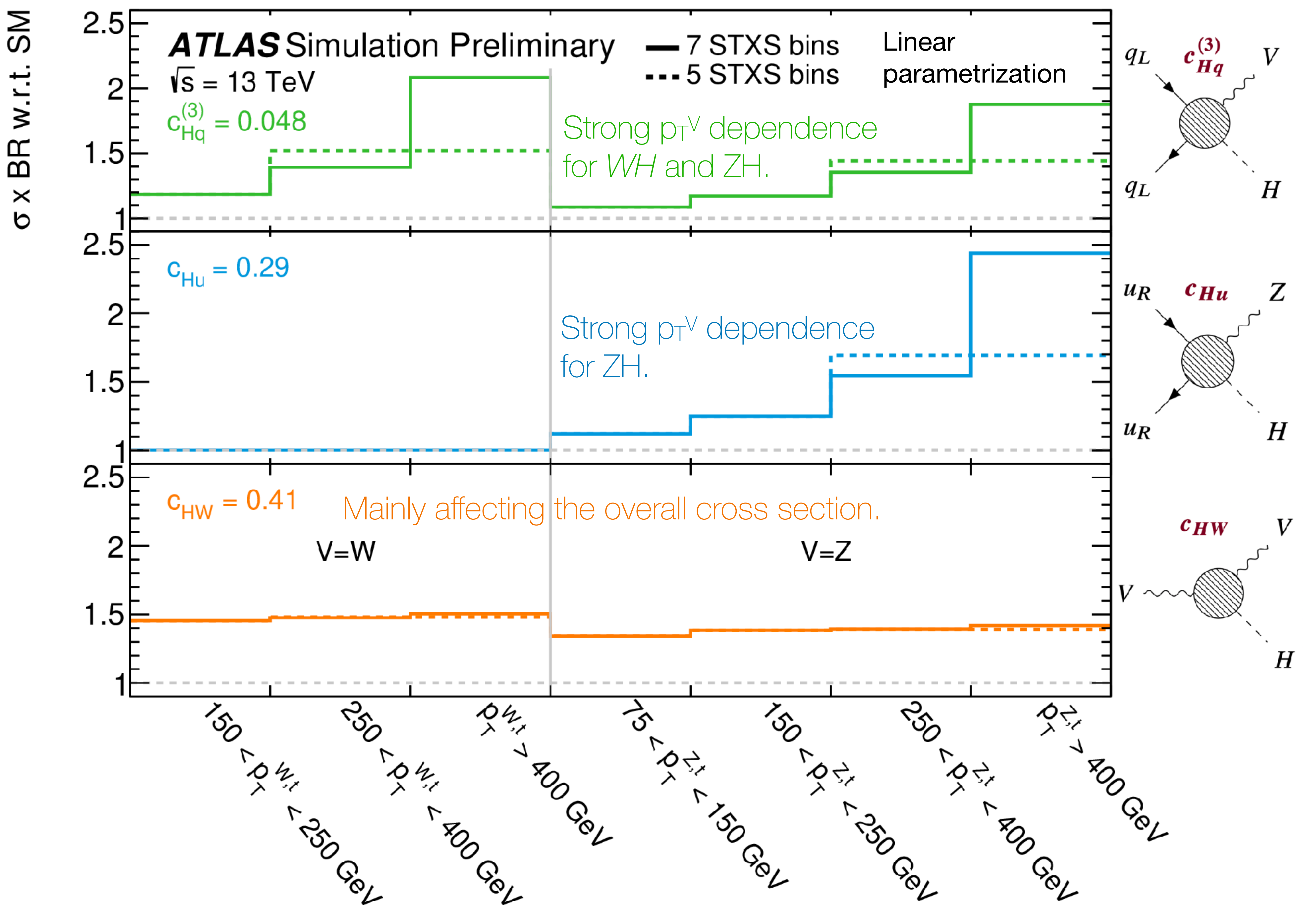
EV1: broad shape in the expected linear+quadratic scan,
partially due to the presence of two degenerate minima from the quadratic dependence.

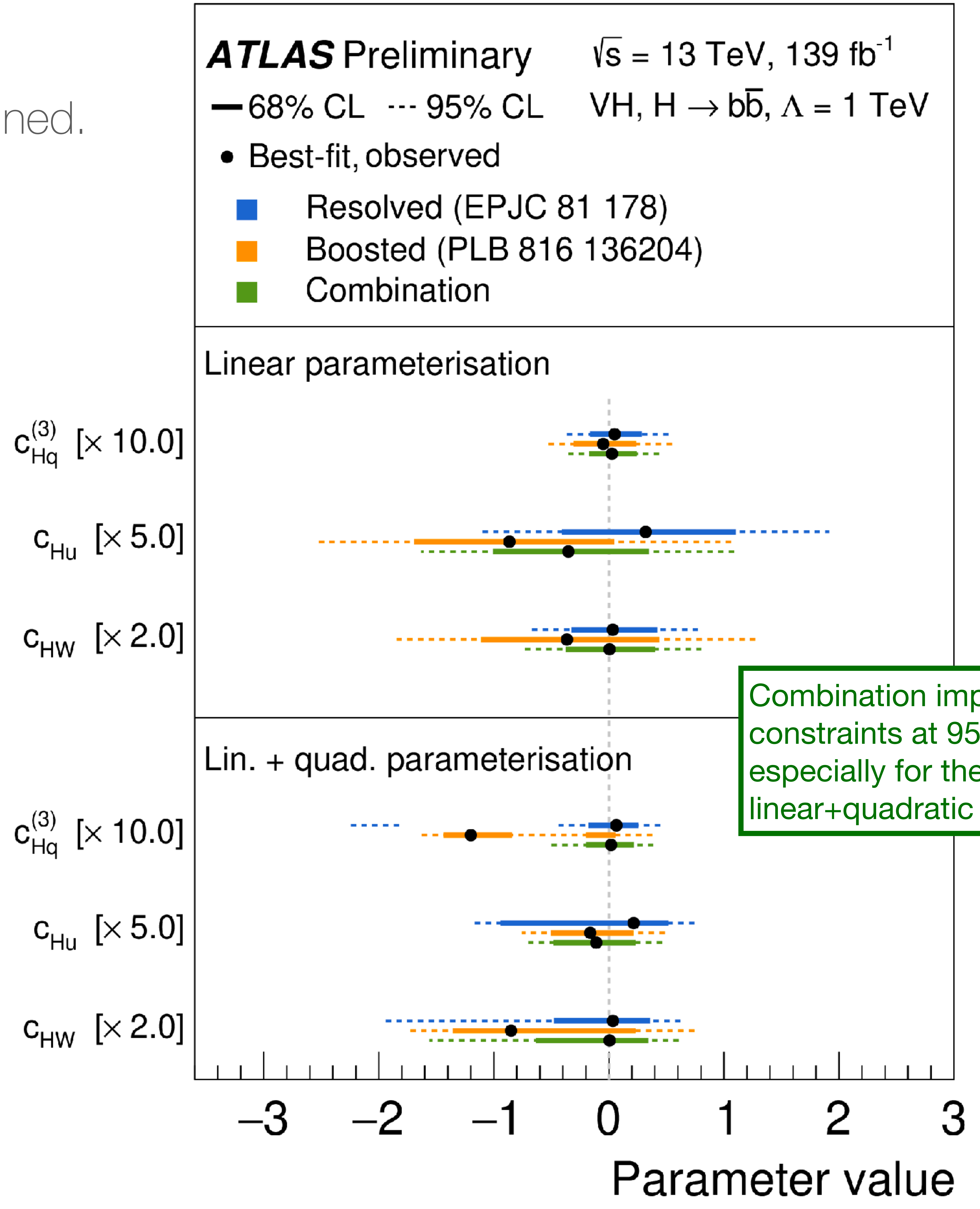
Degeneracy partially lifted in the observed scans, since observed data don't exactly correspond to the SM expectation.

$VH, H \to bb$ simplified template cross sections in SMEFT

ATLAS-CONF-2021-051

- Interpretation performed for each Wilson coefficients individually (setting the others to 0).
- Analyses with resolved and boosted (p_T^V> 400 GeV) topologies combined.

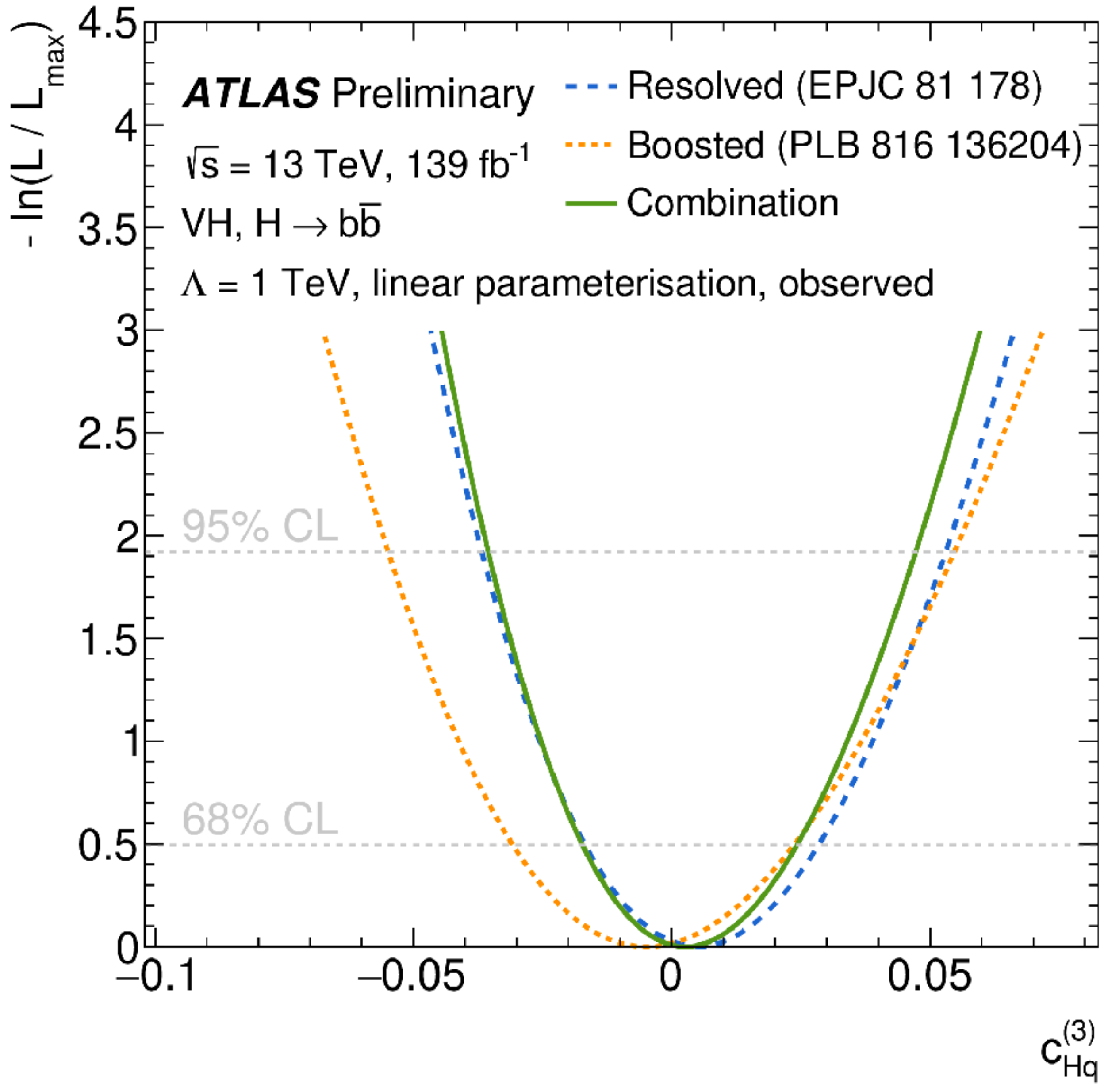


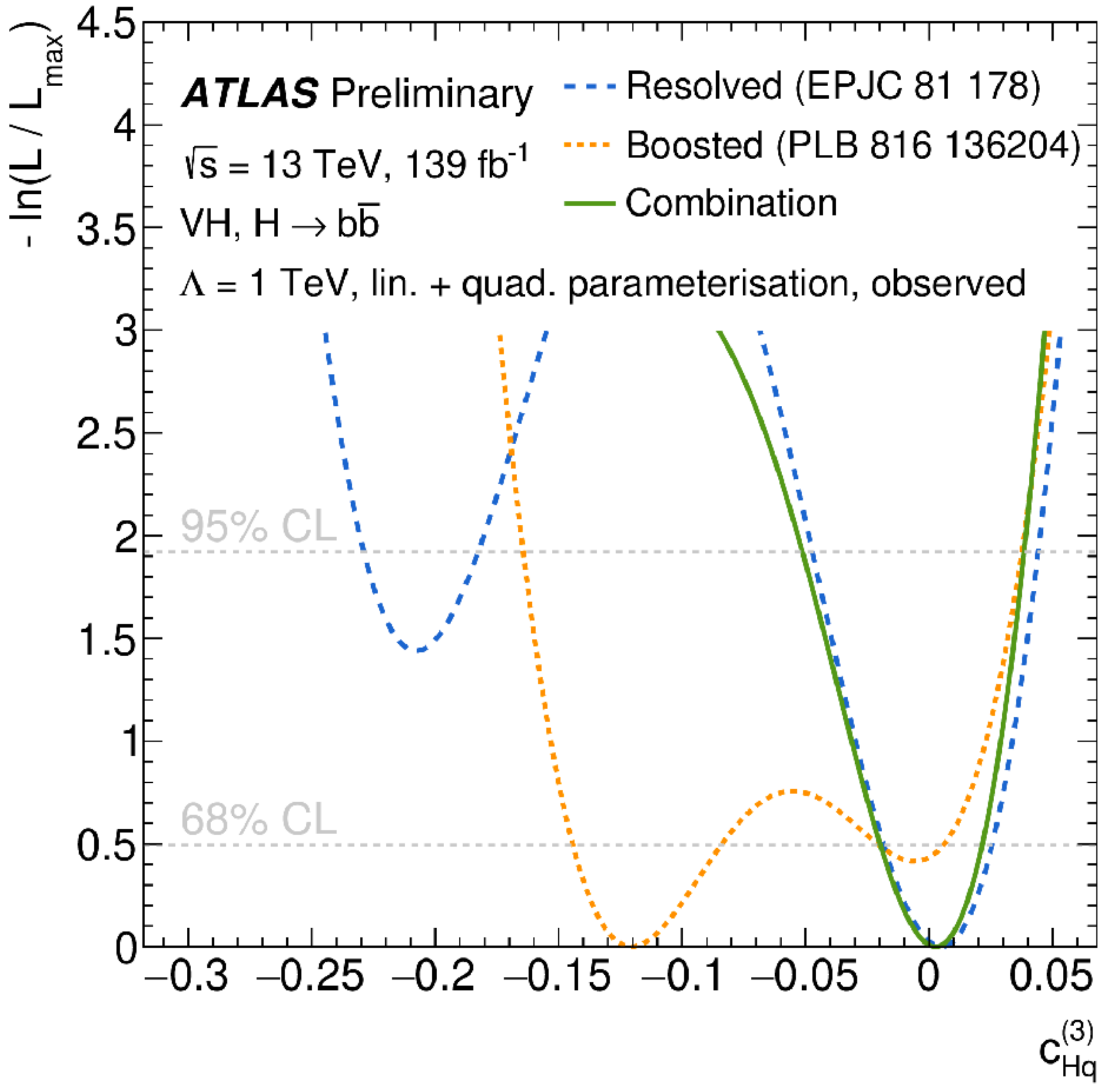


Combination improves constraints at 95% CL, especially for the linear+quadratic model.

$VH, H \to bb$ simplified template cross sections in SMEFT

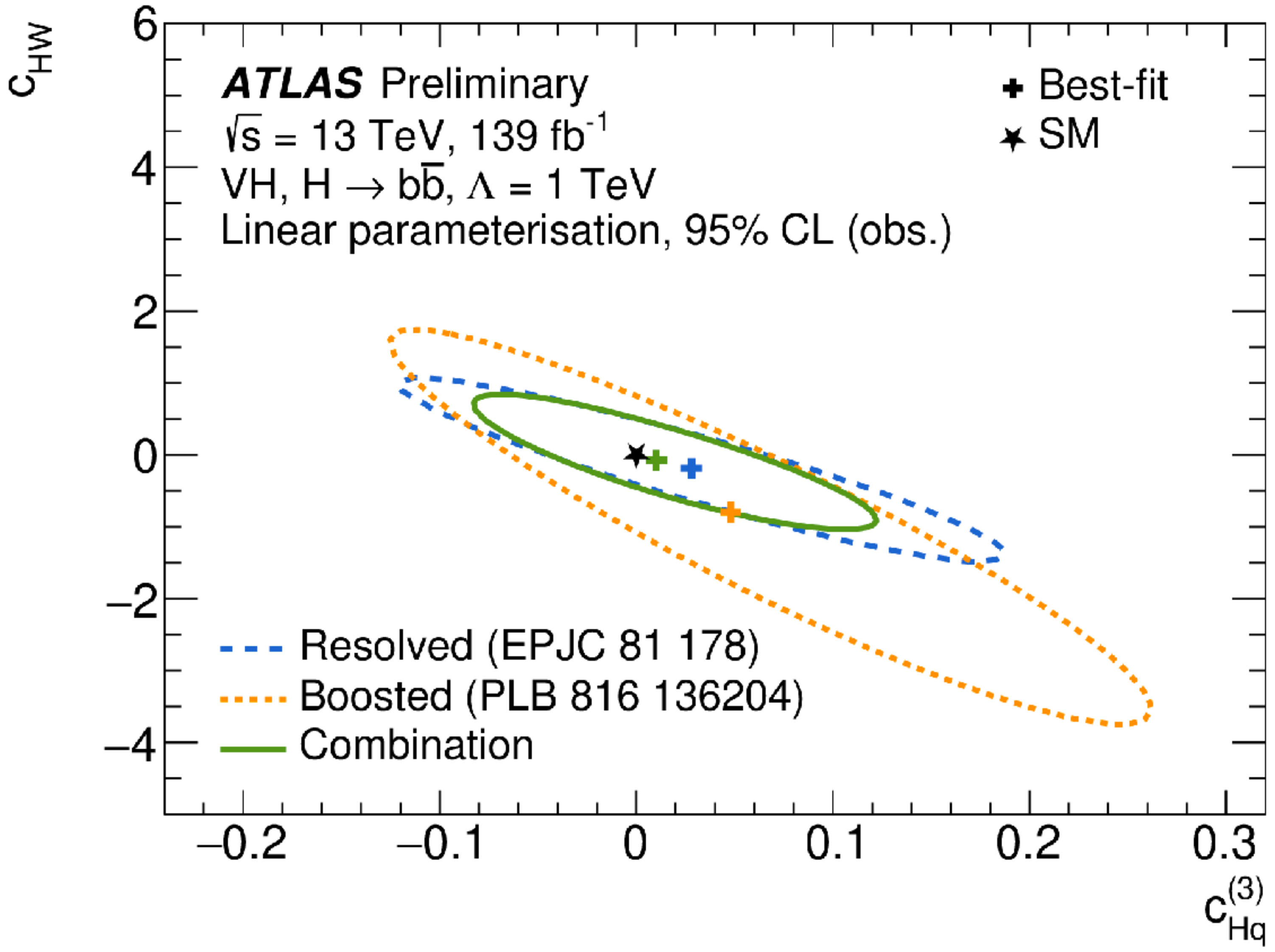
ATLAS-CONF-2021-051

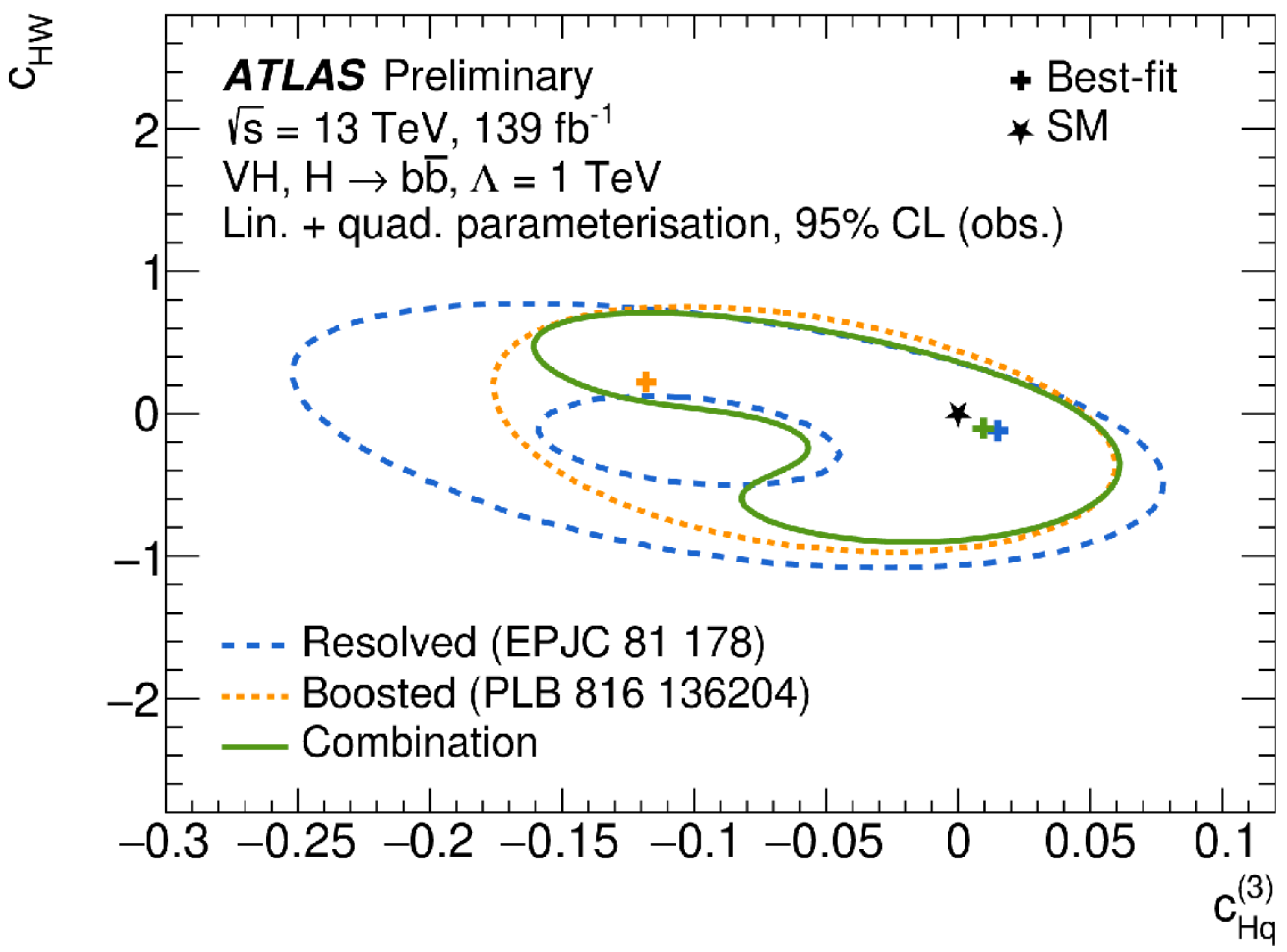




Examples of improvements achieved by including the measurements of high-p_T^V bins using the boosted topology.

Significant improvement achieved despite of the statistically limited measurement precision.





Combined Higgs STXS measurements in SMEFT

ATLAS-CONF-2021-053

Decay channel	Targeted prod. modes	Ref.
$H \to \gamma\gamma$	ggF, VBF, WH, ZH, ttH,tH	[1]
$H \to ZZ^* \to 4\ell$	ggF, VBF, WH+ZH, ttH+tH	[2]
$H \to WW^* \to \ell\nu\ell\nu$	ggF, VBF	[3]
$H \to bb$	VBF, WH, ZH, ttH+tH	[4],[5],[6],[7]
$H \to \tau\tau$	ggF, VBF, WH,ZH, ttH+tH	[8]

[1] ATLAS-CONF-2020-026

[2] Eur. Phys. J. C 80 (2020) 957

[3] ATLAS-CONF-2021-014

[4] Eur. Phys. J. C 81 (2021) 178

[5] Phys. Lett. B 816 (2021) 136204

[6] Eur. Phys. J. C. 81 (2021) 537

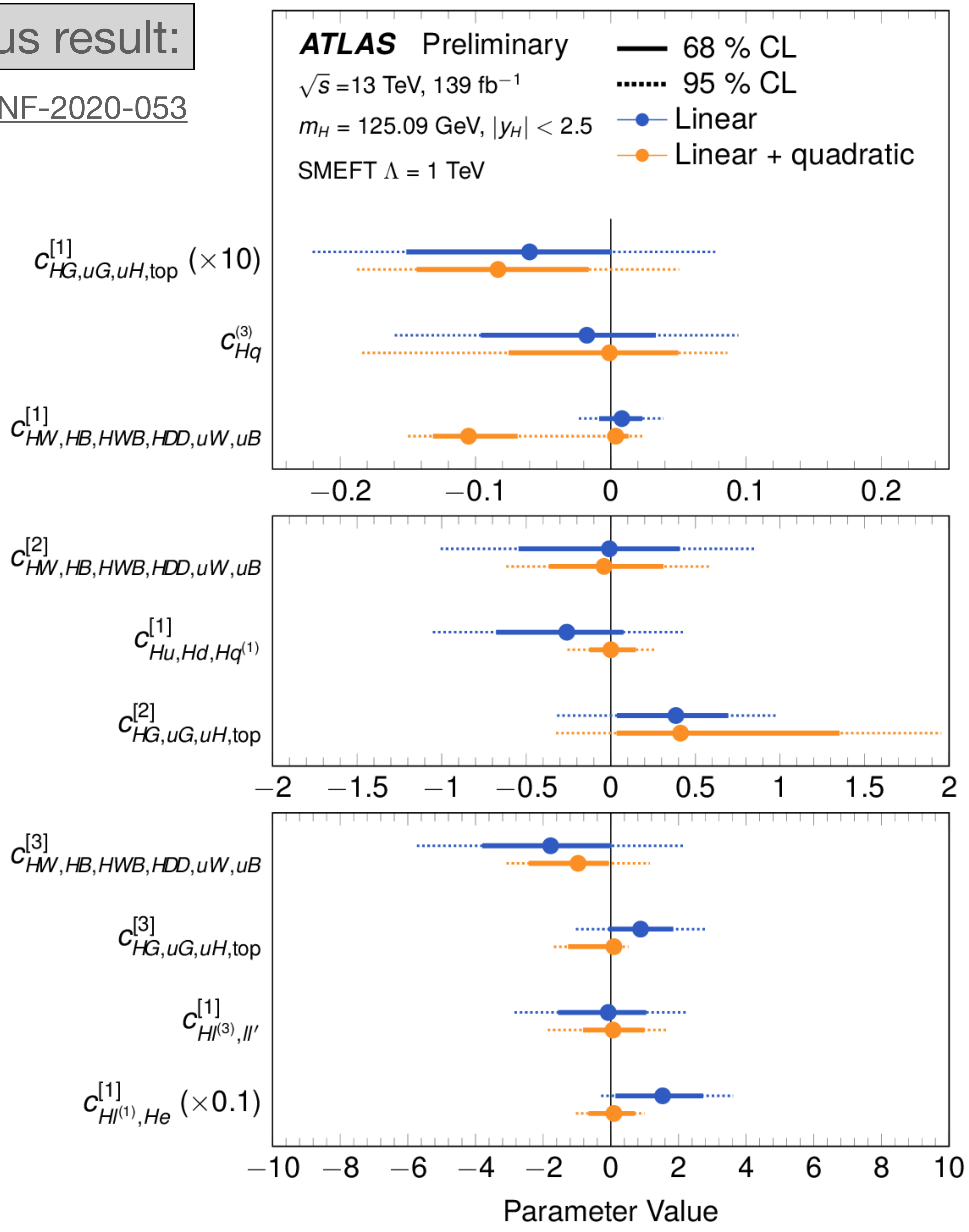
[7] arXiv:2111.06712

[8] ATLAS-CONF-2021-044

Combined Higgs STXS measurements in SMEFT

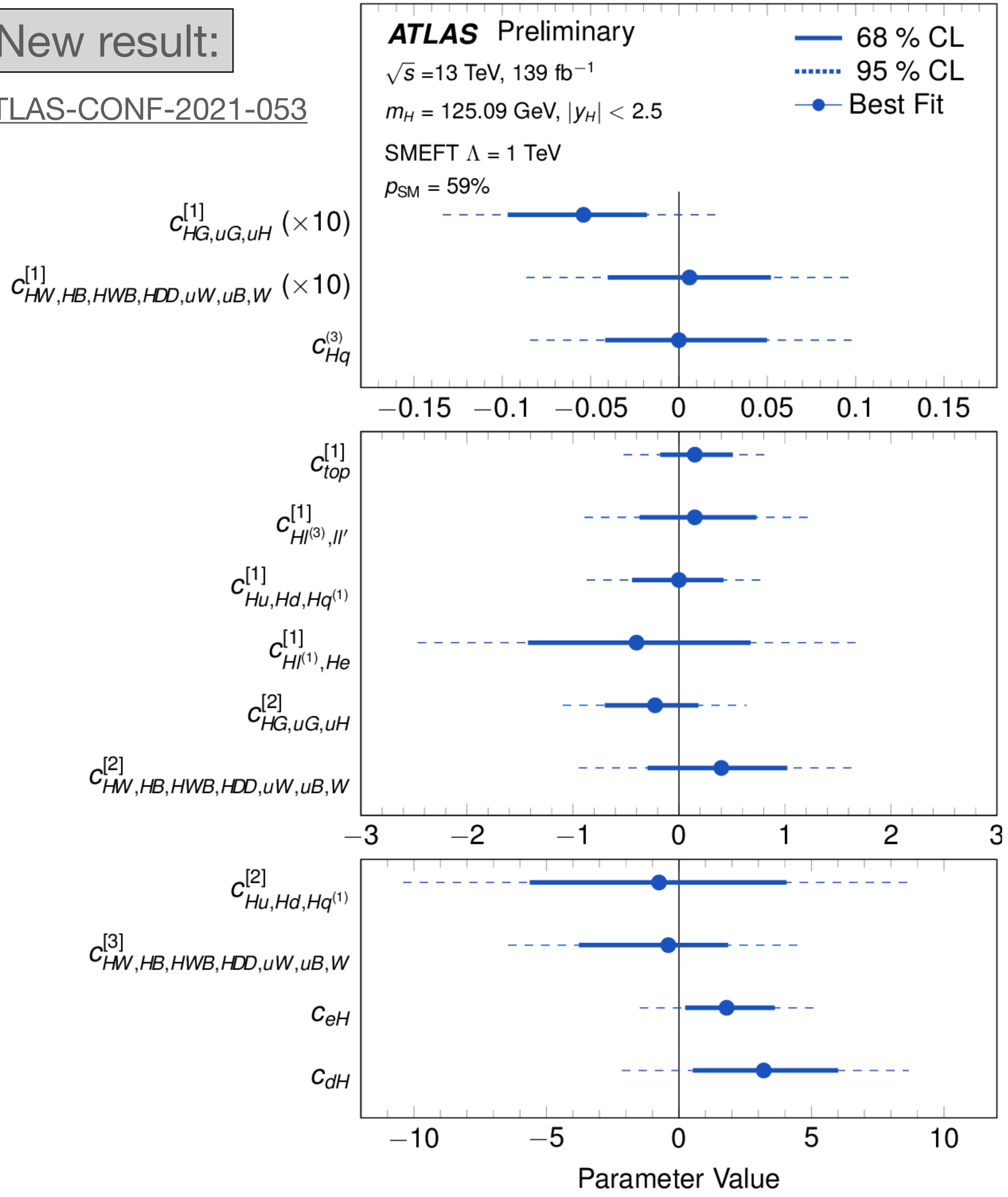
Previous result:

ATLAS-CONF-2020-053



New result:

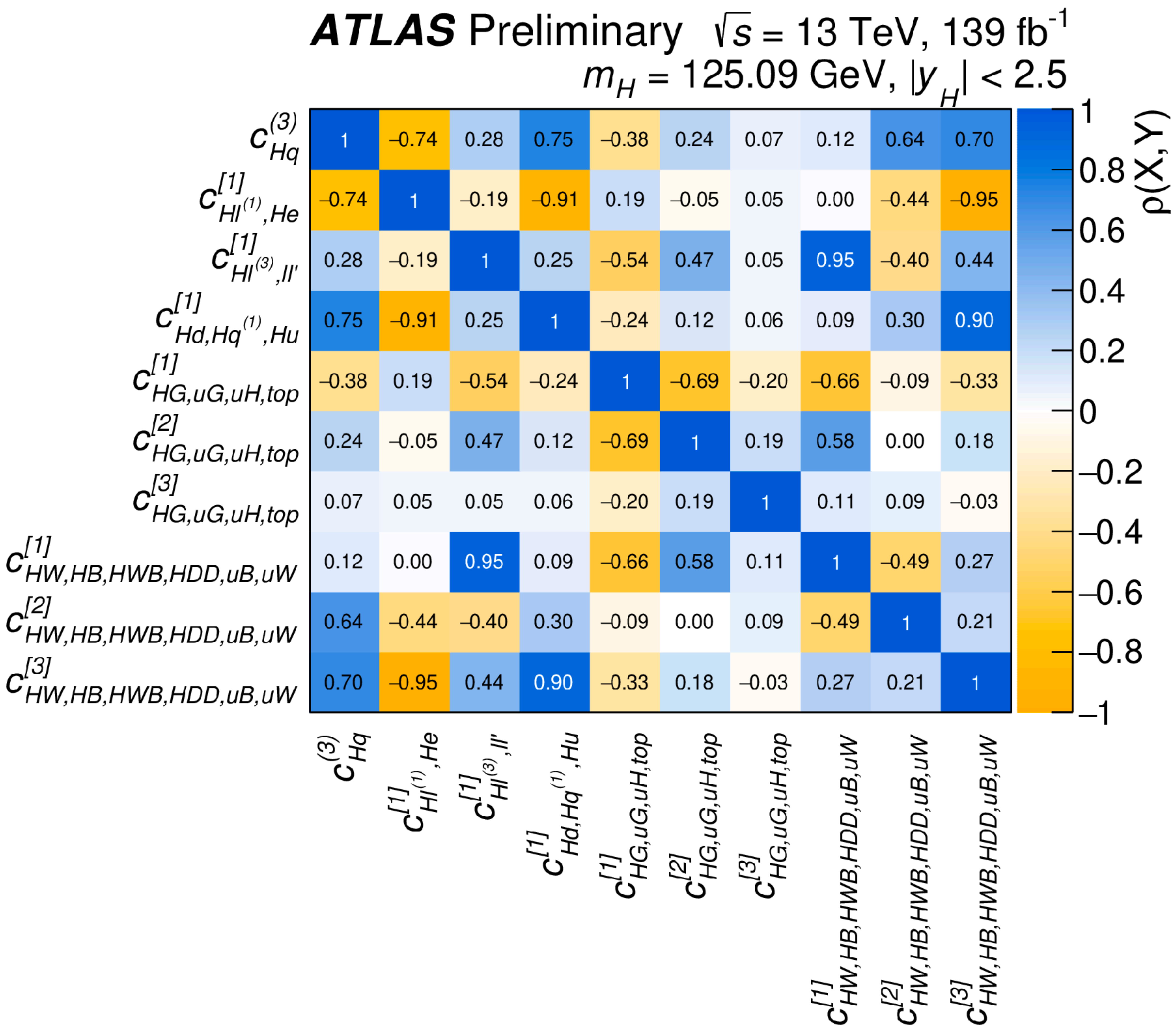
ATLAS-CONF-2021-053



Combined Higgs STXS measurements in SMEFT

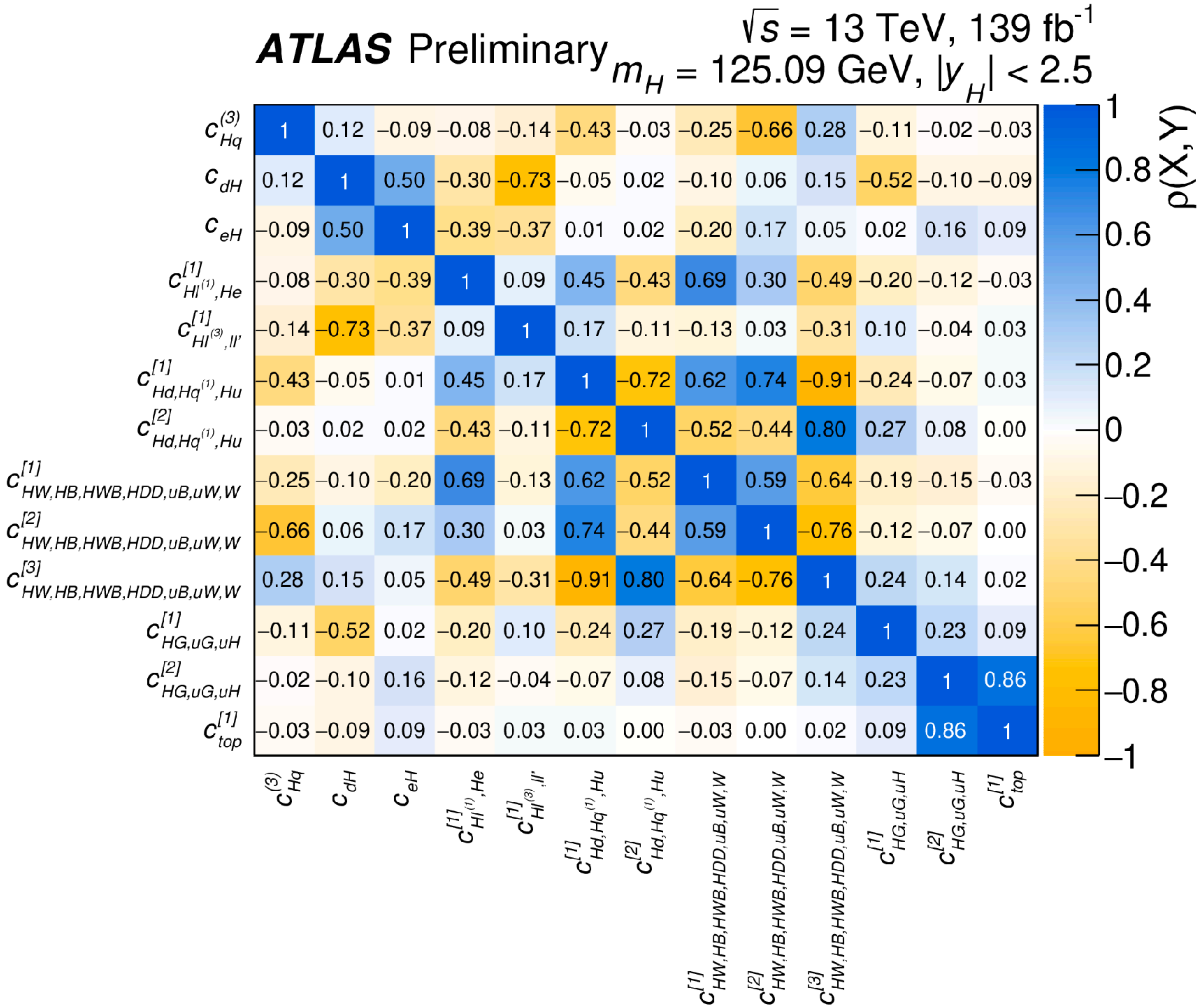
Previous result:

ATLAS-CONF-2020-053



New result:

ATLAS-CONF-2021-053



Global SMEFT fit of Higgs+EW+EWPO data