ATLAS Highlights

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On behalf of the ATLAS collaboration

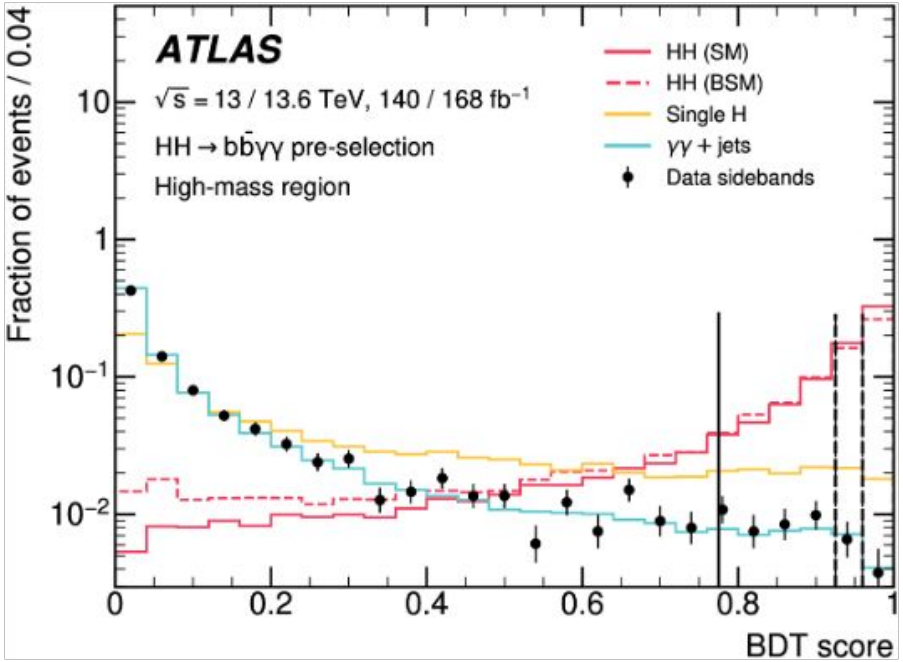
What will be covered in this talk

Focus: Higgs and EFT

- $HH \to b\bar{b}\gamma\gamma$ ATL-PHYS-PUB-2025-034
- $H \to ZZ^*$ and $H \to WW^*$ ATLAS-CONF-2025-002, arXiv:2504.07686
- Combined Higgs and electroweak JHEP 11 (2024) 097, ATL-PHYS-PUB-2022-037

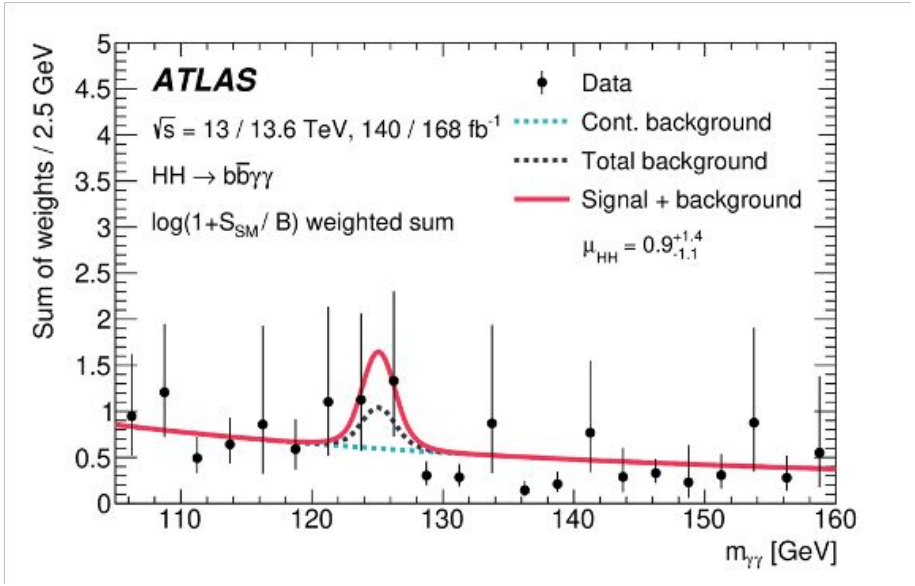
HH→bb̄γγ: Analysis strategy

- First ATLAS result using 308fb^{-1} of data!
- BDT trained in **high** and **low** four-body invariant mass ($m^{*}_{bb\gamma\gamma}$) regions to separate signal from Single Higgs and γγ+jets background
- **BDT score** used to define categories that maximise benchmark signal counting significance
- 11 γγ+jets events required in each category → Run-2 and Run-3 **correlated** to allow for tighter BDT score cuts



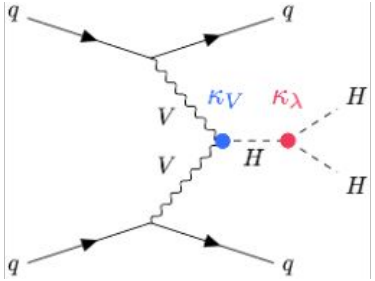
HH→bb̄γγ: Coupling result

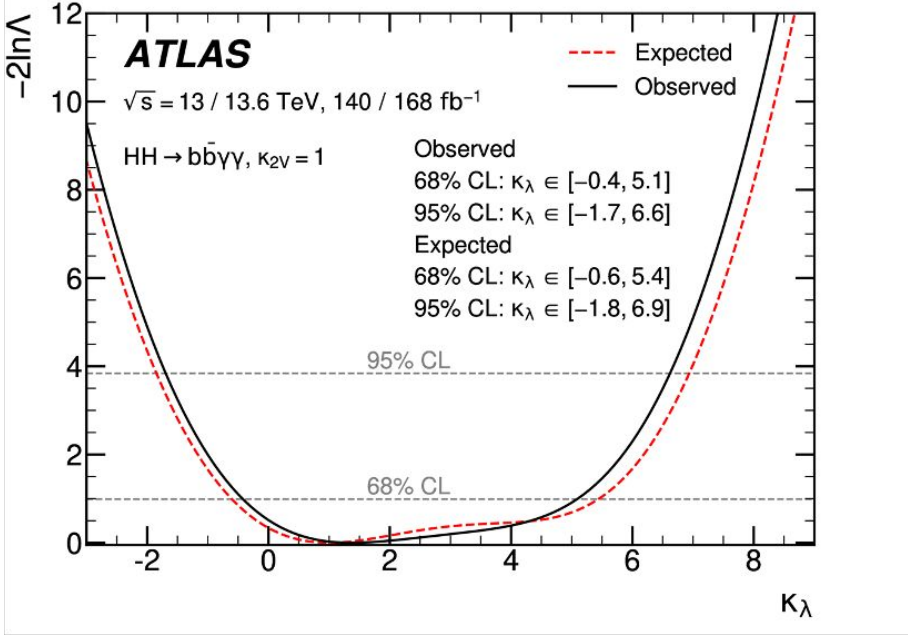
- Unbinned Maximum Likelihood fit over all 14 categories yields best-fit $\mu_{HH} = 0.9^{+1.4}_{-.1.1}$
- First HH result to reach **1σ expected significance**!
- Upper limit of μ_{HH}**<3.8** set on HH signal strength



HH→bb̄γγ: Kappa result

- Limits set on Higgs self-coupling at the 95% confidence level:
- $\kappa_\lambda \in [-1.7, 6.6]$
- Limits **competitive with the Run 2 legacy HH combination** ($\kappa_\lambda \in [-1.2, 7.2]$)

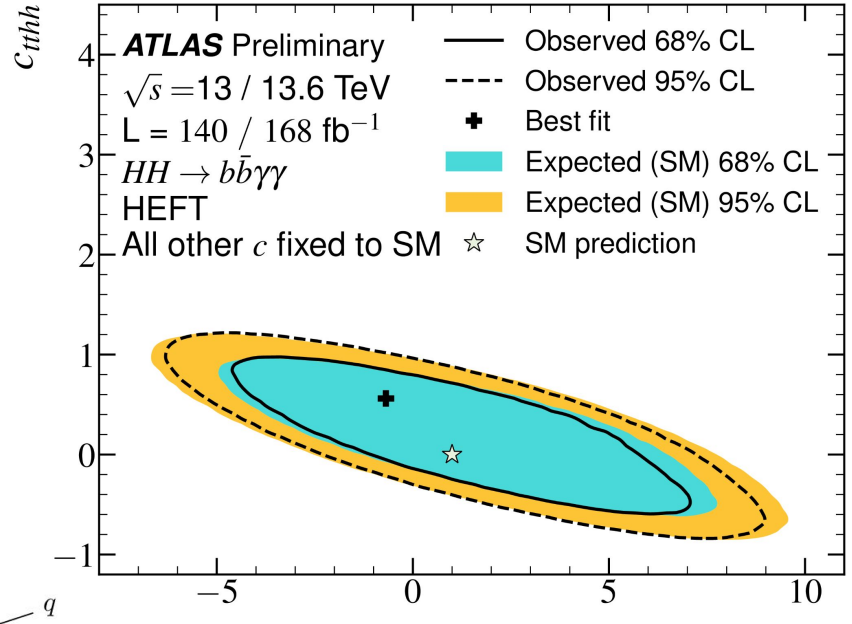


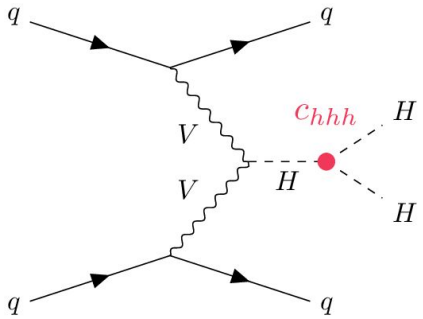


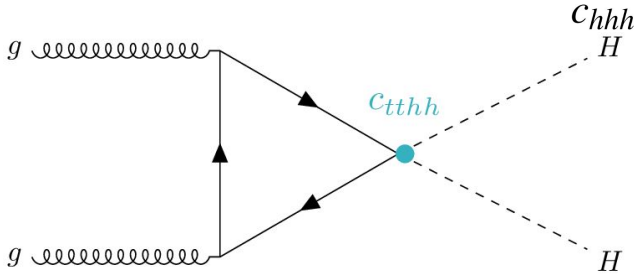
HH→bb̄γγ: HEFT result

First EFT interpretation from the ATLAS experiment based on over 300 fb^{-1} of data

24% − 45% improvement with respect to constraints obtained from an analysis of 140 fb^{-1} of data collected

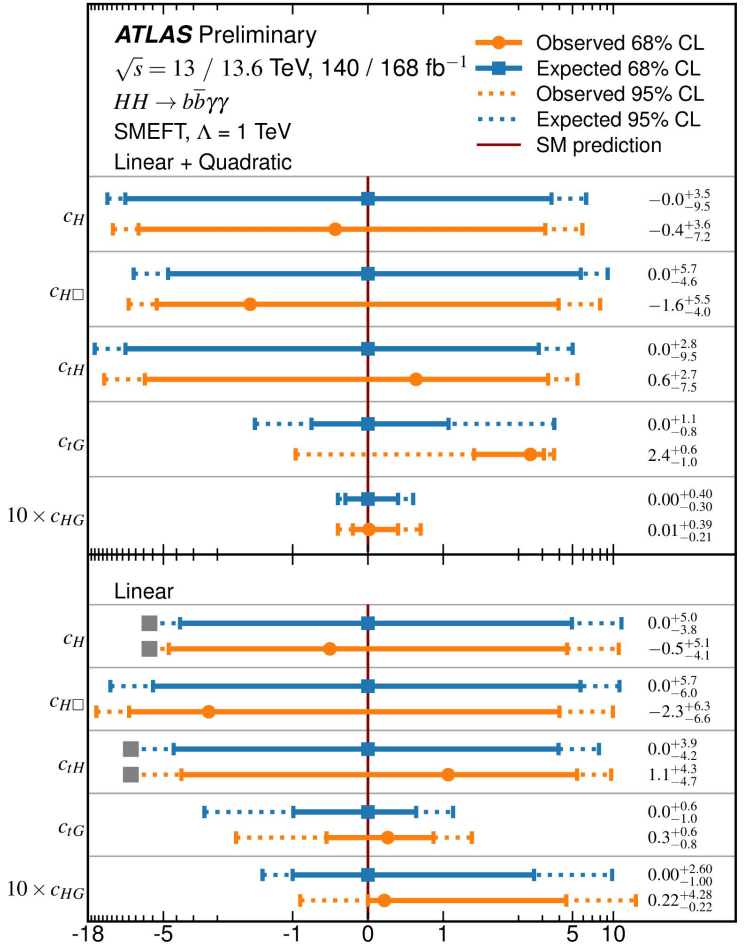






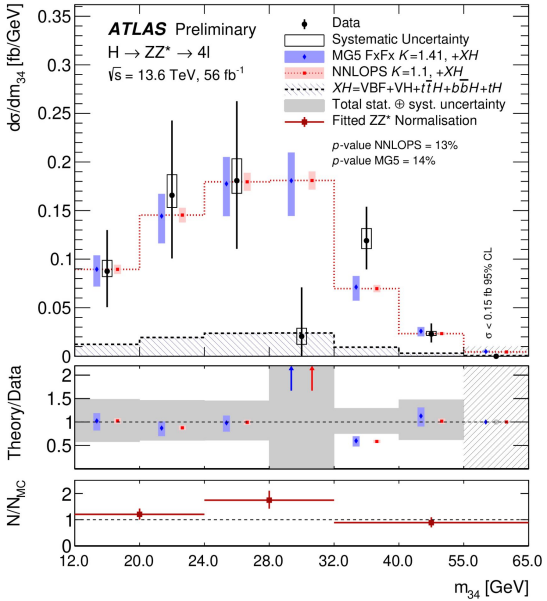
HH→bb̄γγ: SMEFT result

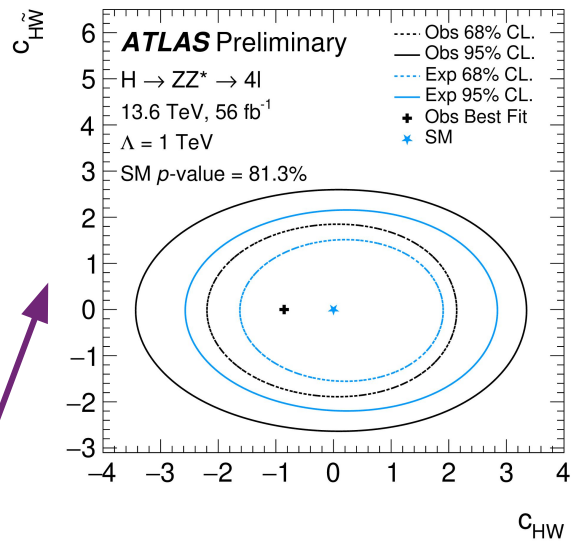
Constraints on SMEFT cH , $cH\Box$ Wilson coefficients improve by 30% − 50% relative to the previously reported constraints obtained from an analysis of 140 fb^{-1} of data collected

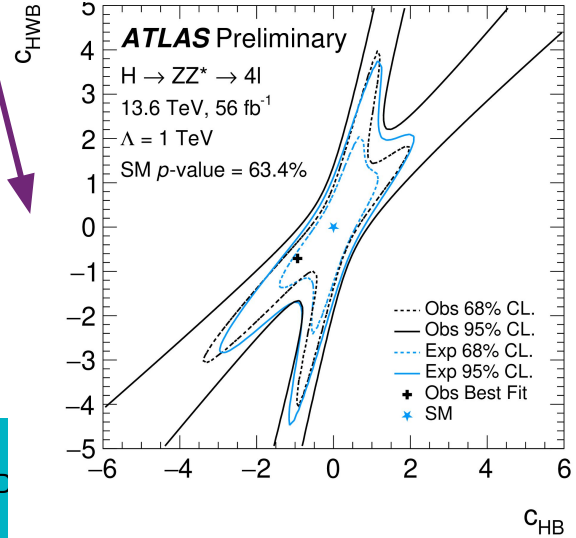


H→ZZ* and H→WW*

- 56 fb^{-1} of $\sqrt{s}$ = 13.6 TeV (Run 3)
- The differential cross-section as a function of dilepton mass is used to set limits on EFT operators.

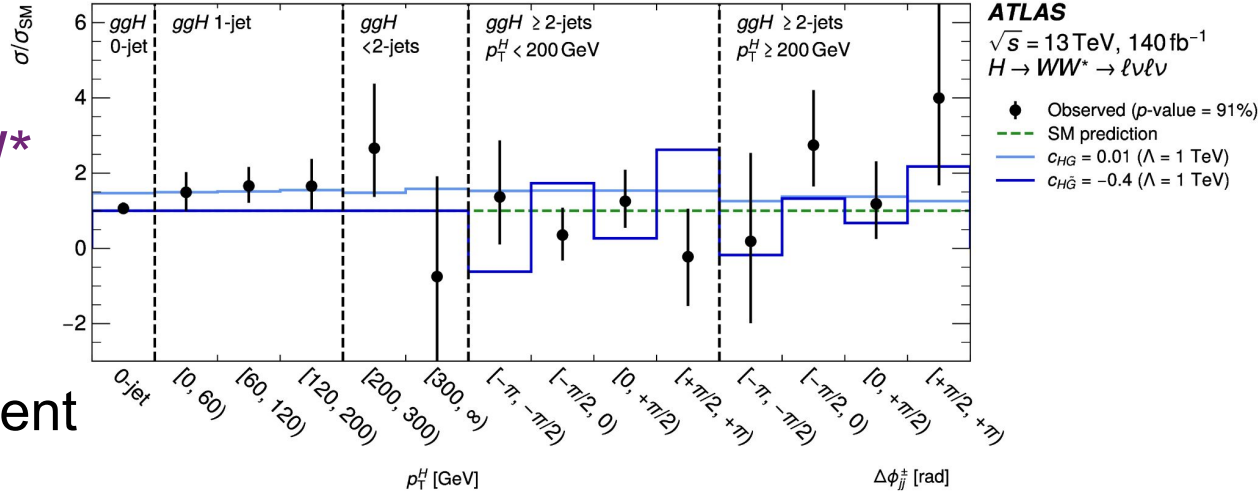


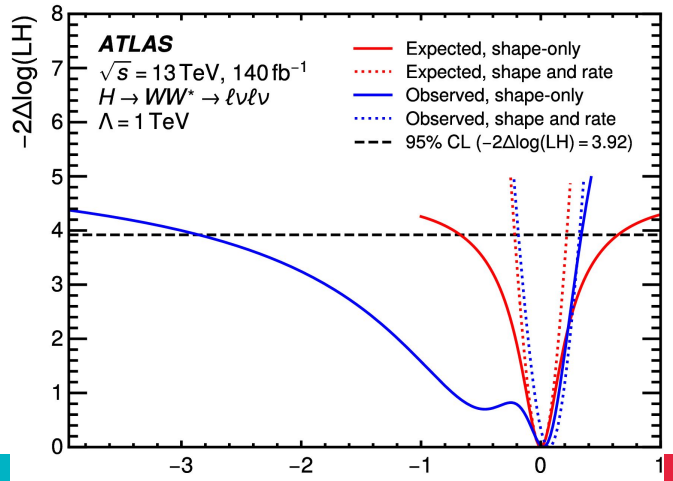




H→ZZ* and H→WW*

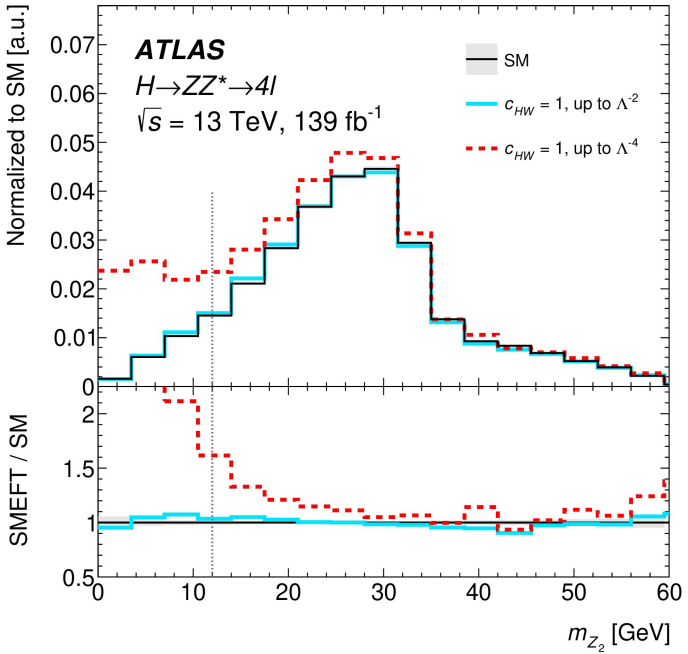
- 140 fb^{-1} Run 2 data
- 11%-36% improvement
- Characterised through STXS measurements in a total of 15 categories
- STXS and $\Delta\phi_{jj}$ measurement used for EFT interpretation, with and without CP-violating operators.

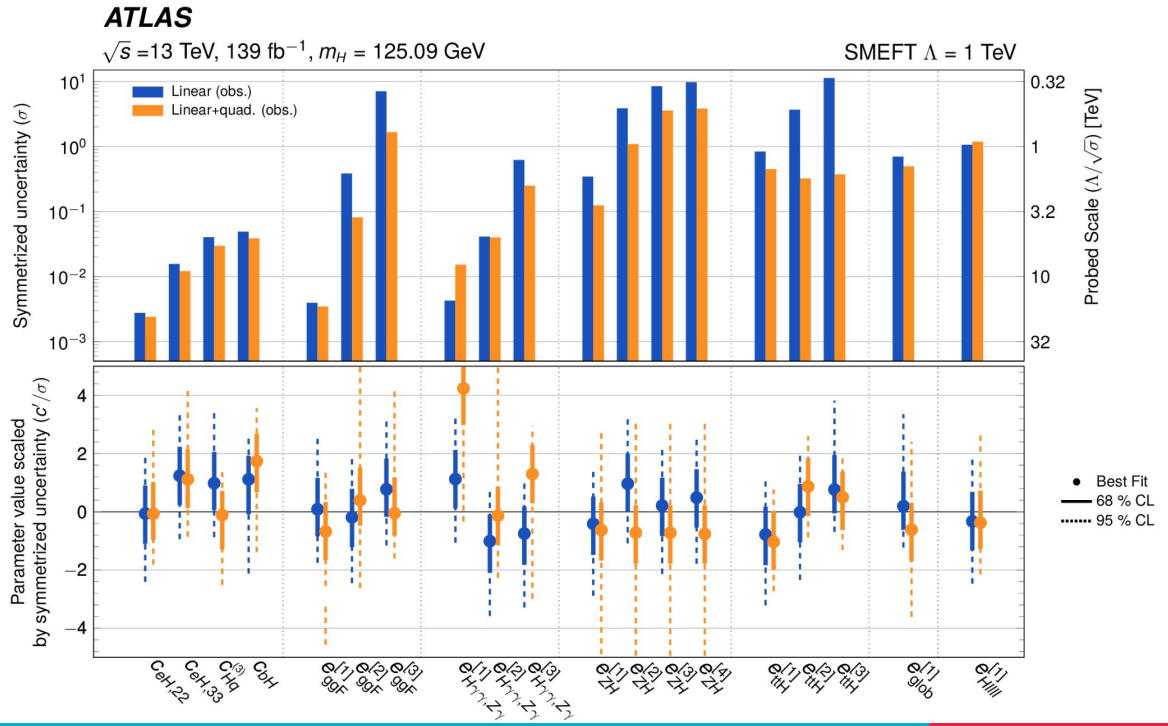




Combined Higgs measurement

Rotated basis c′





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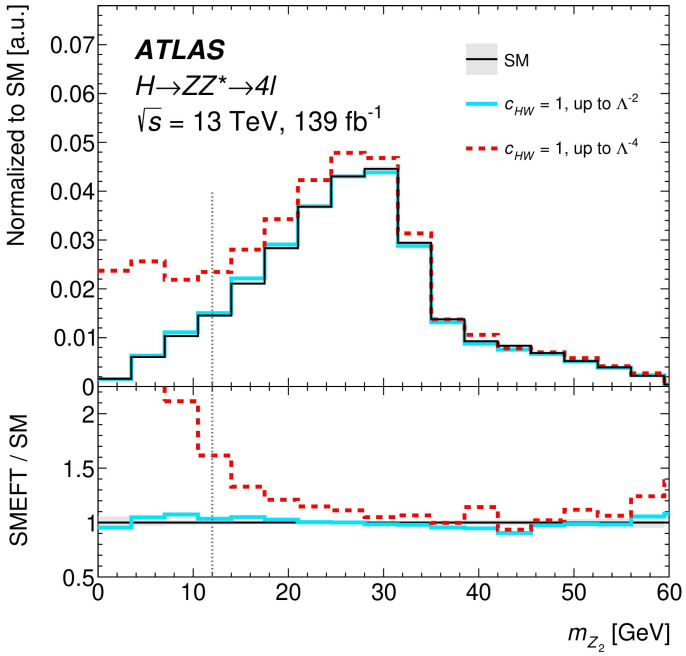
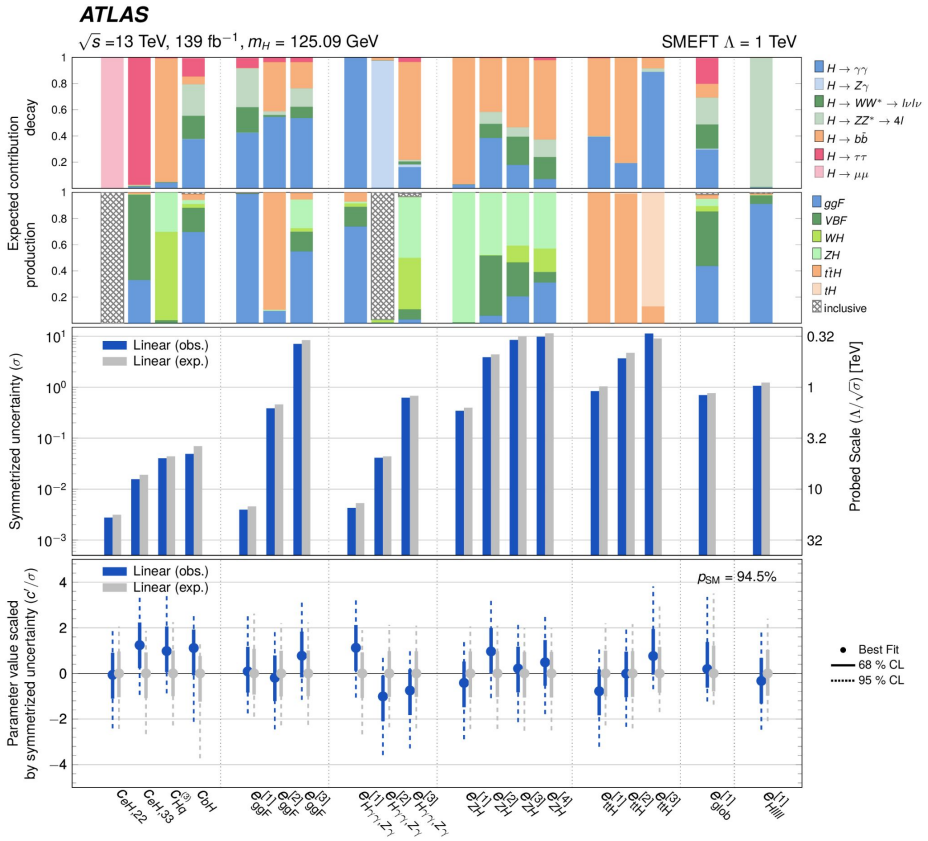


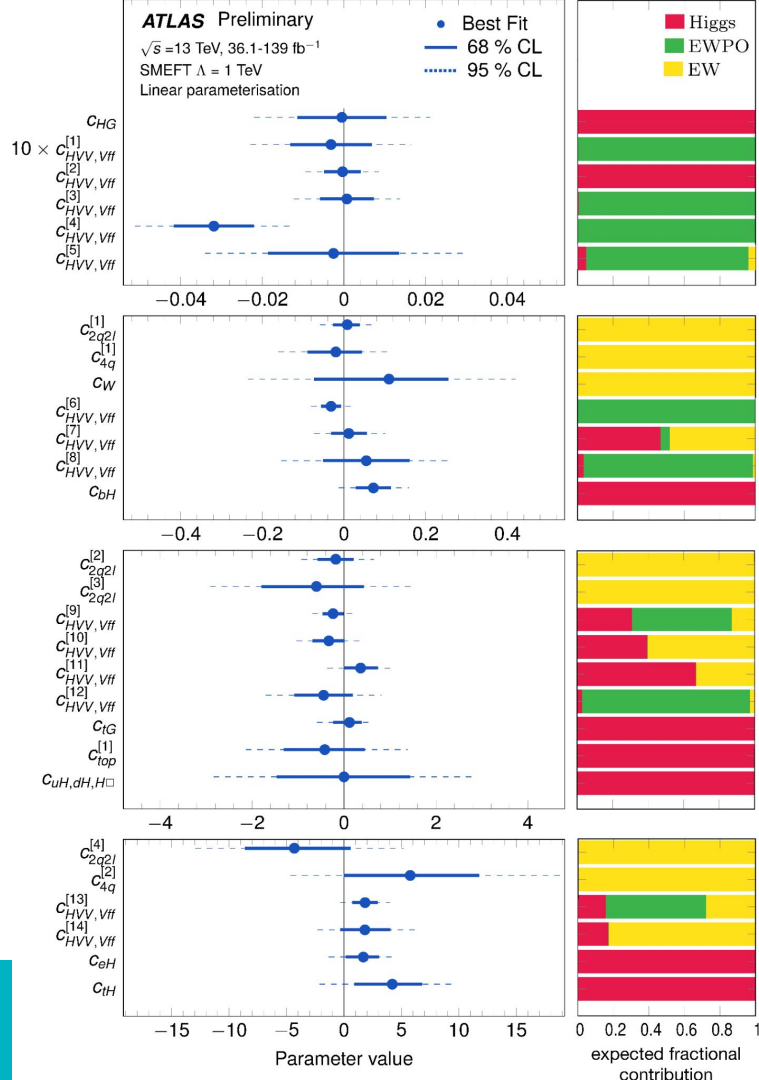


Higgs combined with Electroweak

- Higgs production and decay
- Weak boson production
- Electroweak precision observables measured at the LEP and SLC colliders

Simultaneous constraints of up to 28 directions in parameter space are obtained.

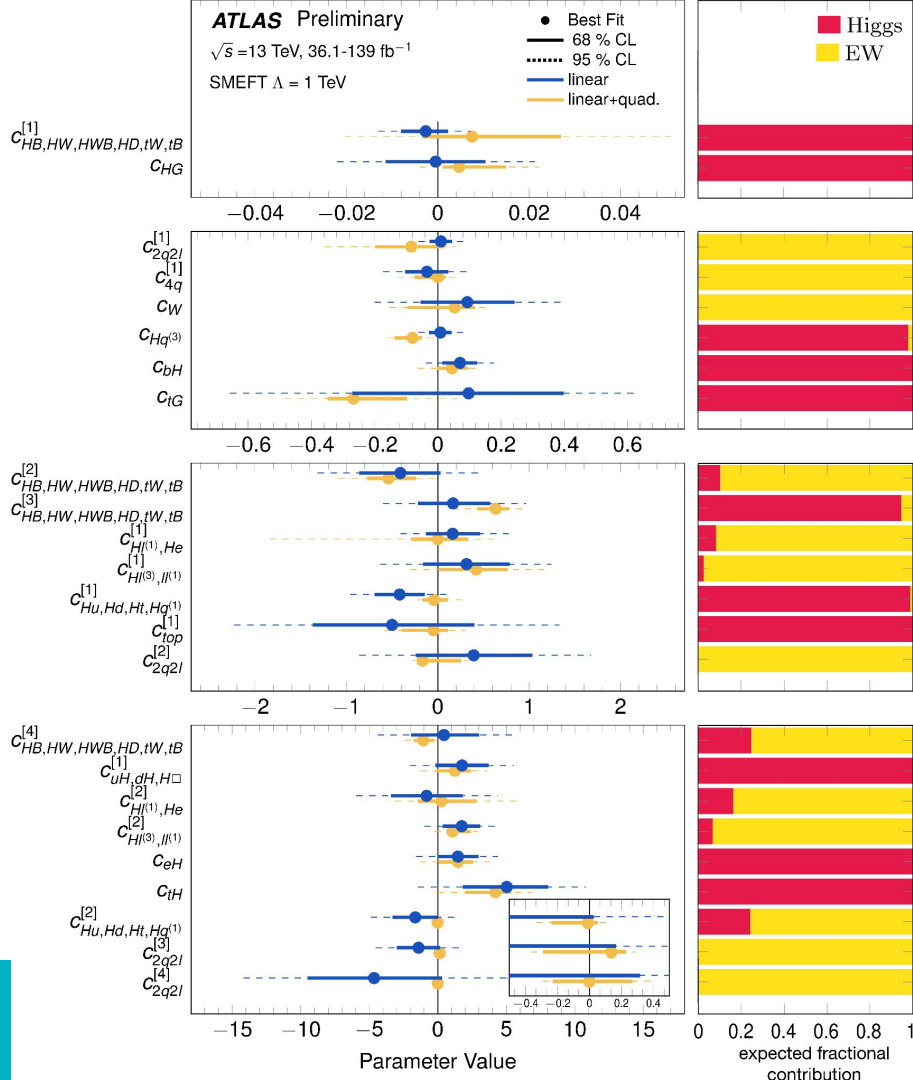
Stay tuned!



Summary

I did not have enough time to cover all EFT/Higgs results, so these are personal highlights

- First EFT interpretation from the ATLAS experiment based on over 300 fb^{-1} of data
- Single Higgs, di-Higgs and combined with EW results
- With and without CP-violating operators
- Simultaneous constraints of up to 28 parameters
- Improvements with respect to previous analyses of up to 50%

Back-up

Higgs combined with EW