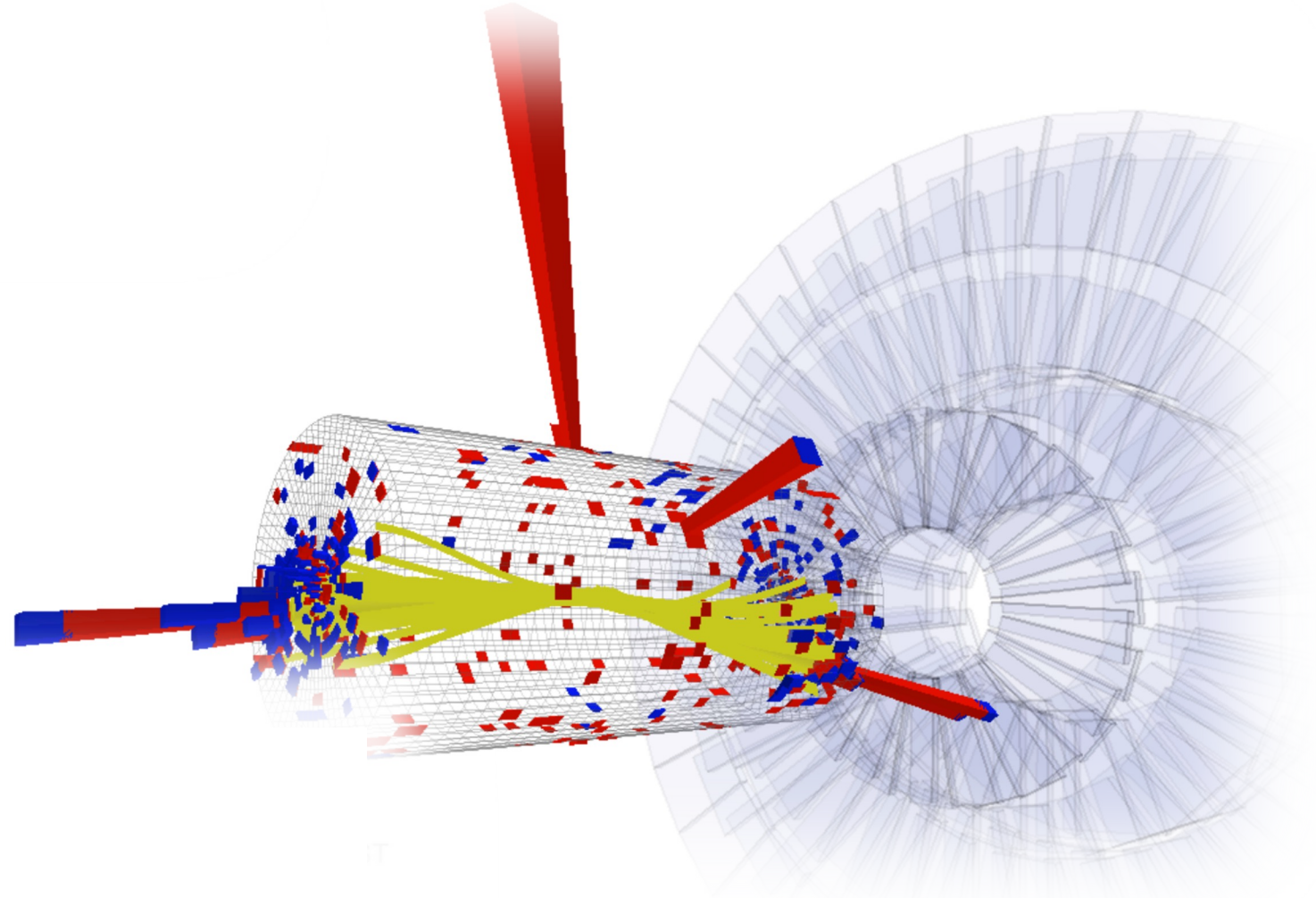


IMPERIAL

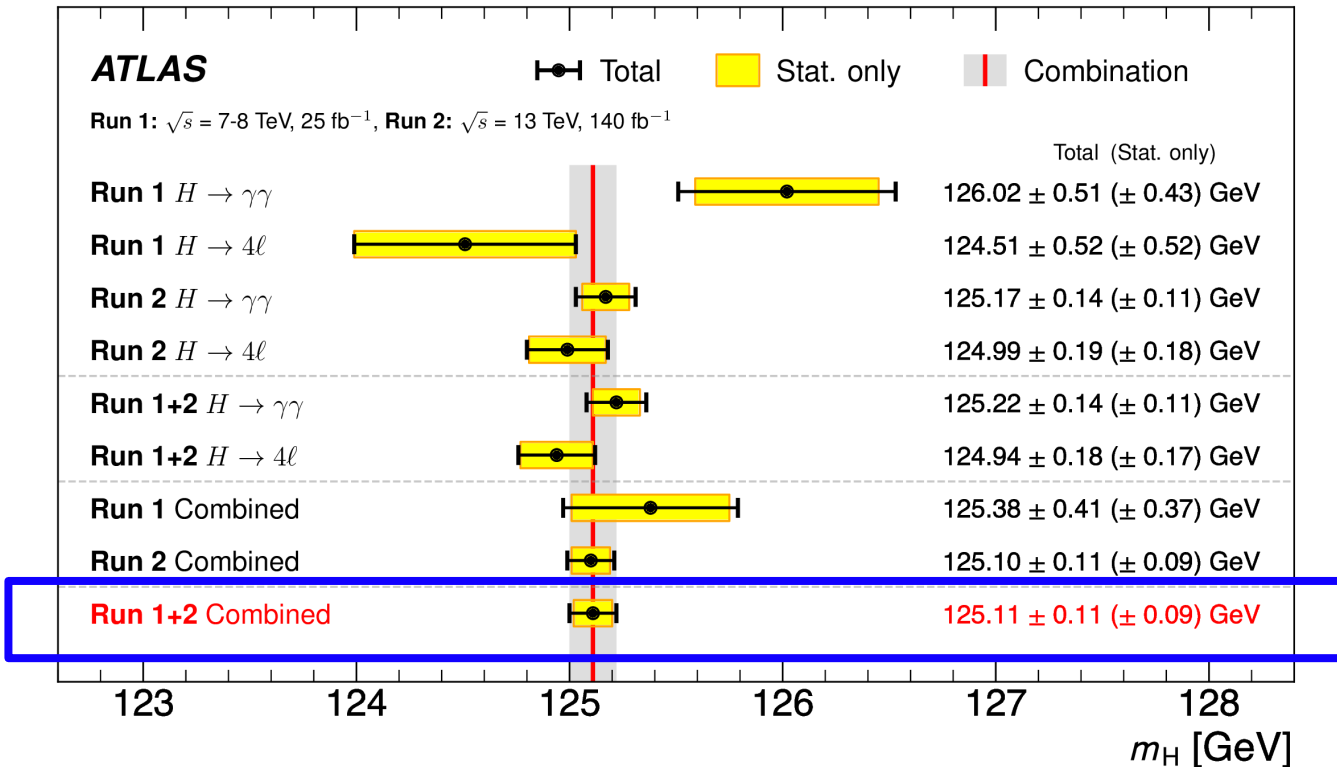
Higgs Boson Properties and Couplings: 3-slide overview

Nicholas Wardle  
Imperial College London

Higgs Hunting
15 – 17 July 2025



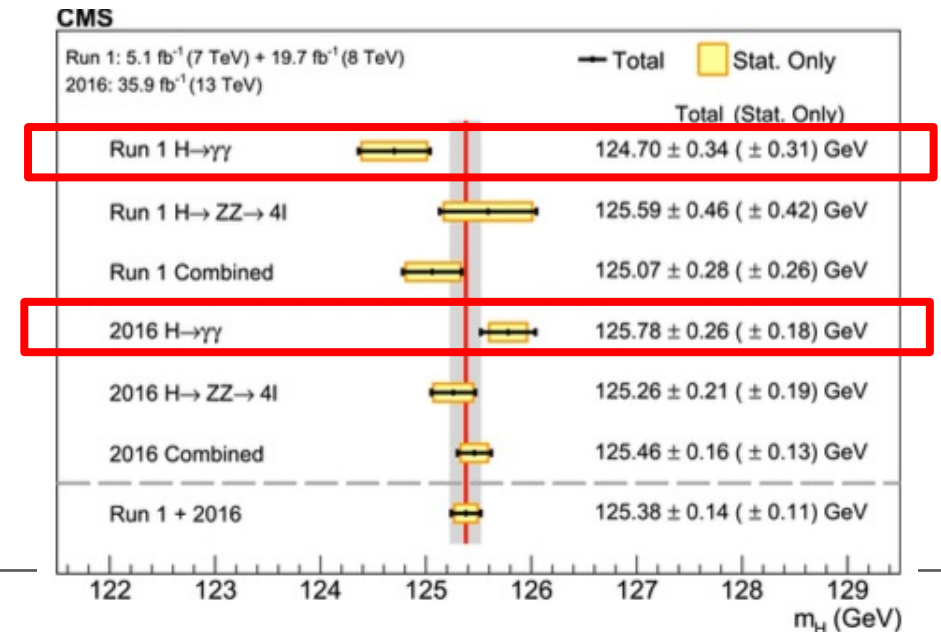
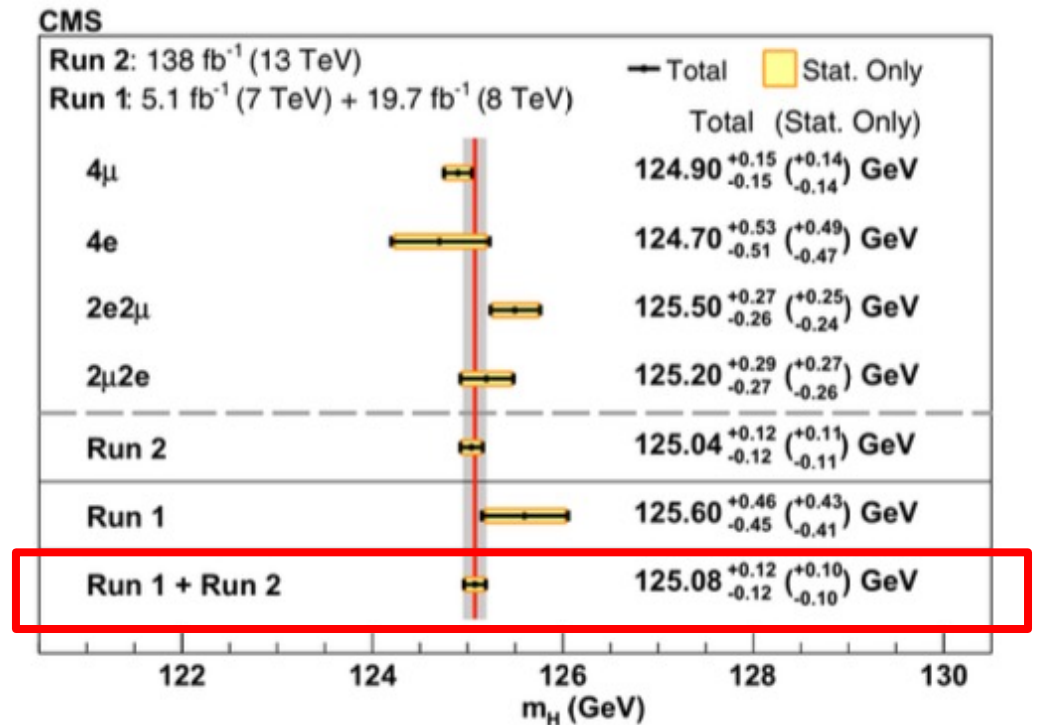
Higgs boson mass and width



ATLAS: Full Run-1+Run-2 in $H \rightarrow \gamma\gamma$ & $H \rightarrow 4\ell$

CMS: Full Run-1+Run-2 in $H \rightarrow 4\ell$, partial Run-2+Run-1 in $H \rightarrow \gamma\gamma$

- Both experiments closing in on **100 MeV** precision!
- Statistics limited → increased precision with Run-3 data, but CMS working hard to reduce scale systematics in full Run-2



Higgs boson mass and **width**

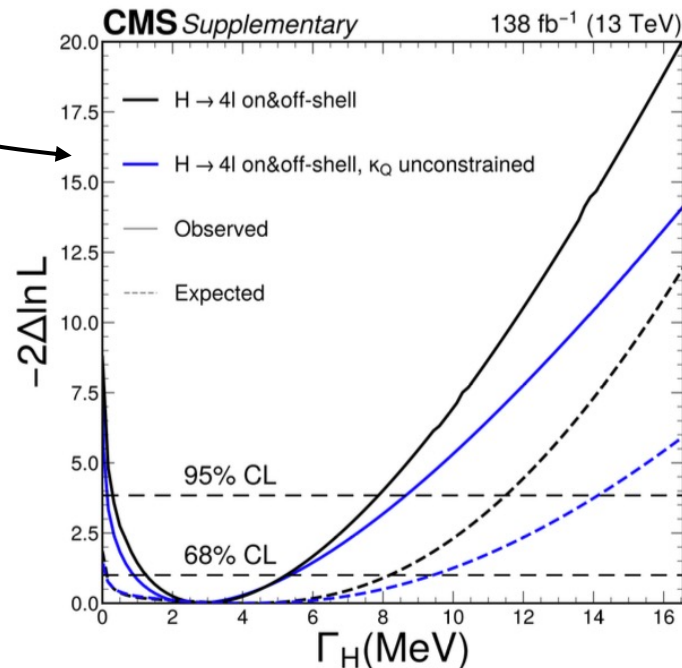
Off-shell measurements combined with on-shell production provides strongest **indirect** constraint on Γ_H

Eg in $H \rightarrow 4l/2l2\nu$

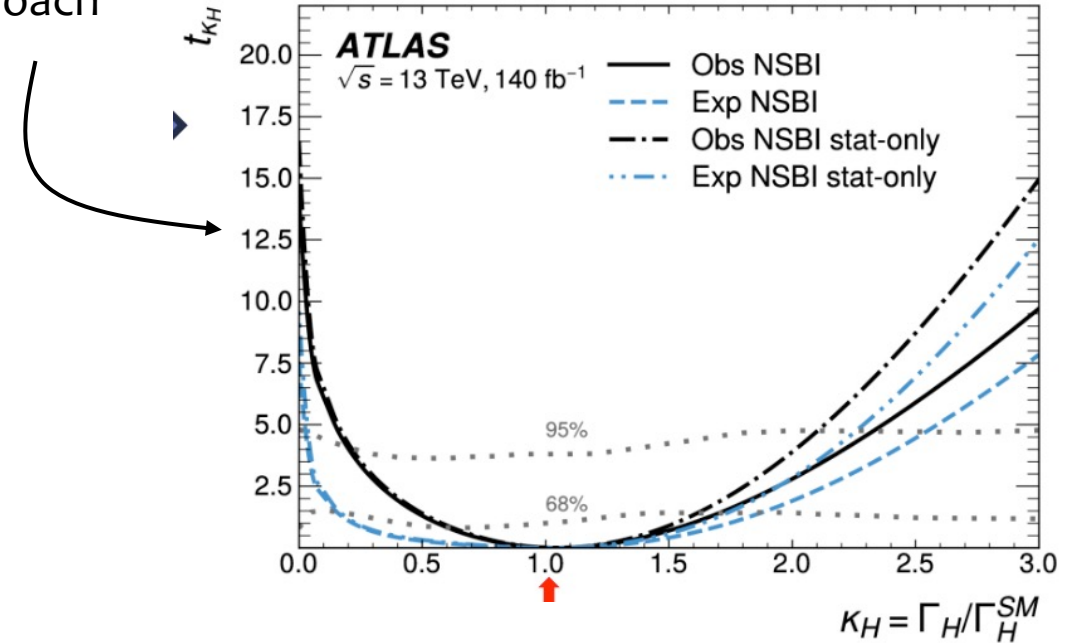
CMS: $\Gamma_H = 3.0^{+2.0}_{-1.5} \text{ MeV}$

ATLAS: $\Gamma_H = 4.3^{+2.7}_{-1.9} \text{ MeV}$

- Explore sensitivity to SM assumptions
→ e.g allow for NP in ggH loops



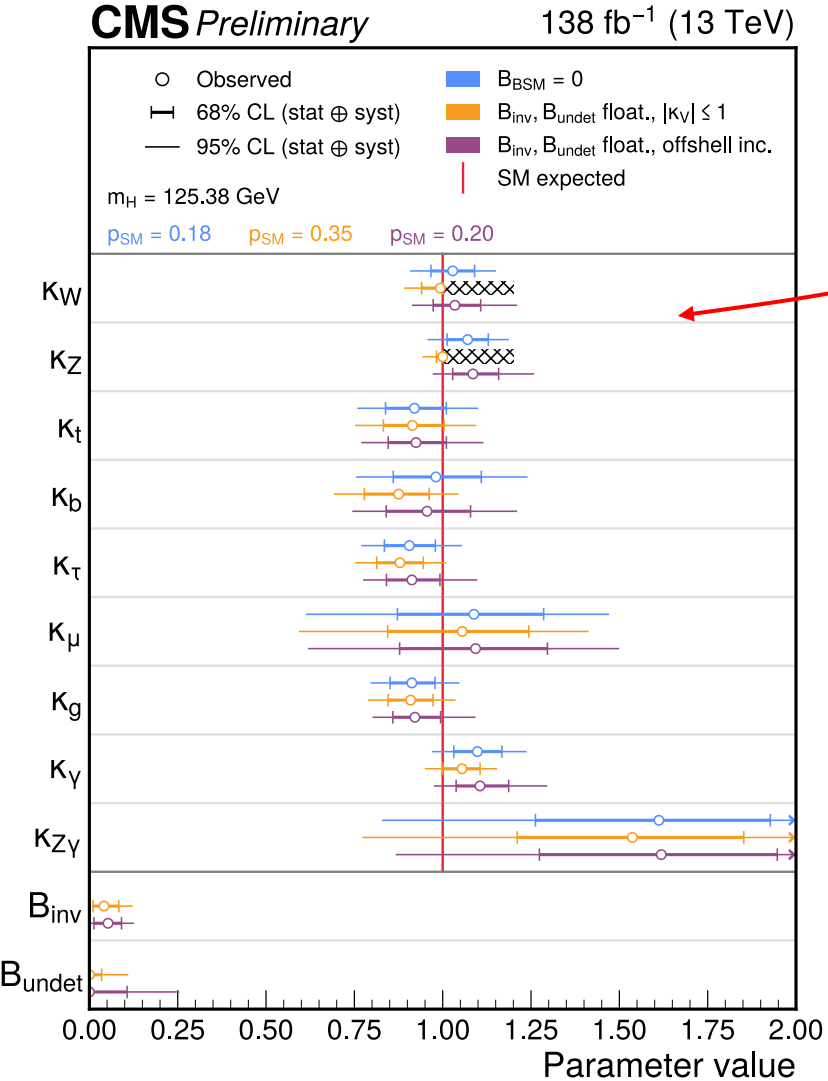
- Explore new ideas to squeeze out sensitivity from the data
→ SBI approach



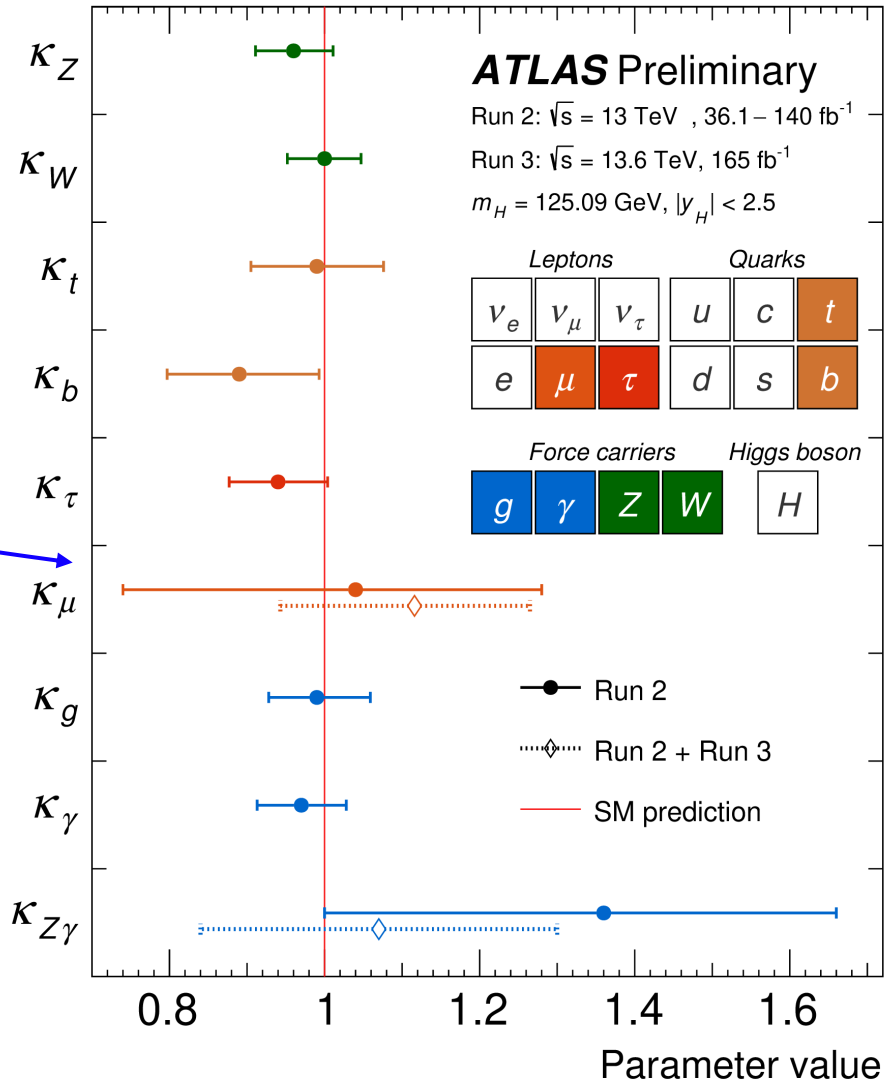
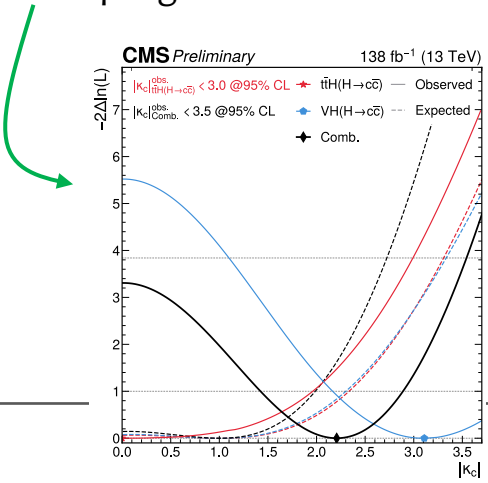
- Both ATLAS/CMS also study $H \rightarrow WW$ and $t\bar{t}t\bar{t}$ process to further constrain Γ_H
- Direct measurements yield 50 MeV uncertainty → complementary but not at the level to provide comparable sensitivity

Higgs boson couplings

CMS and ATLAS coupling* combination from full Run-2!



- Inclusion of offshell results allows relaxation of $k_V < 1$ constraint when also exploring BSM decay modes (constraint on $Γ_H$)
- First Run-3 results entering the coupling plots!
→ 30% / 38% improvement in $κ_μ / κ_{Zγ}$ from including Run-3 data !
- Second generation couplings a major target for Run-3
 - $H → μμ$ evidence at both expts.
 - $κ_c$ the next milestone for H-couplings measurements



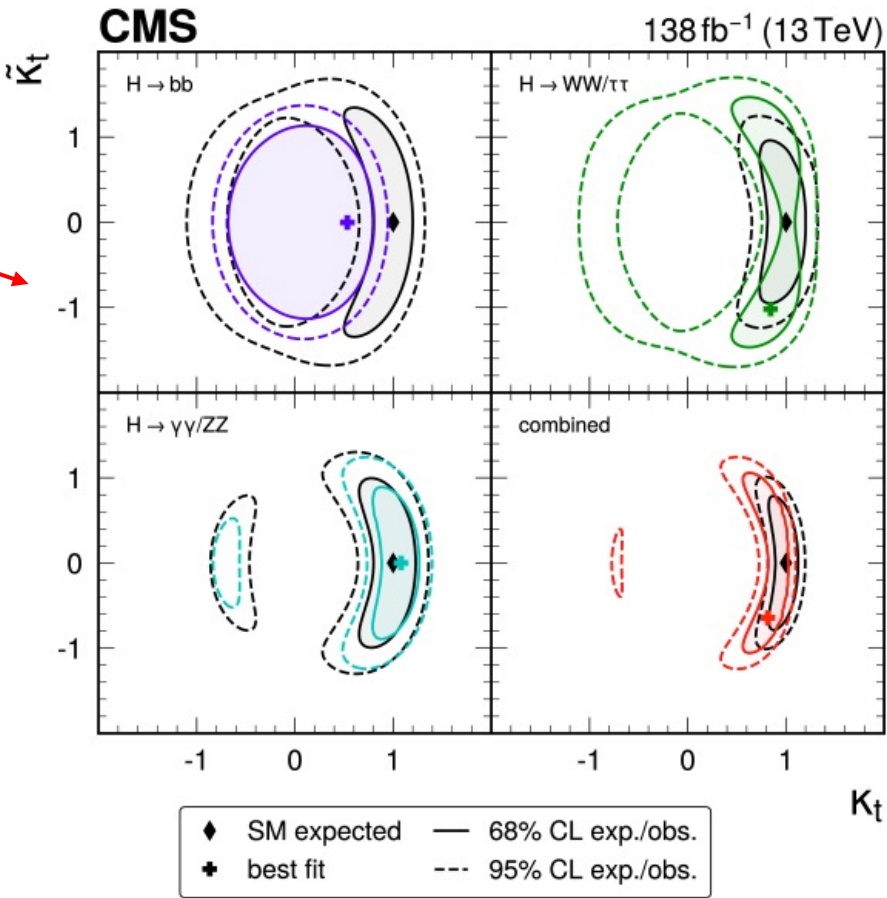
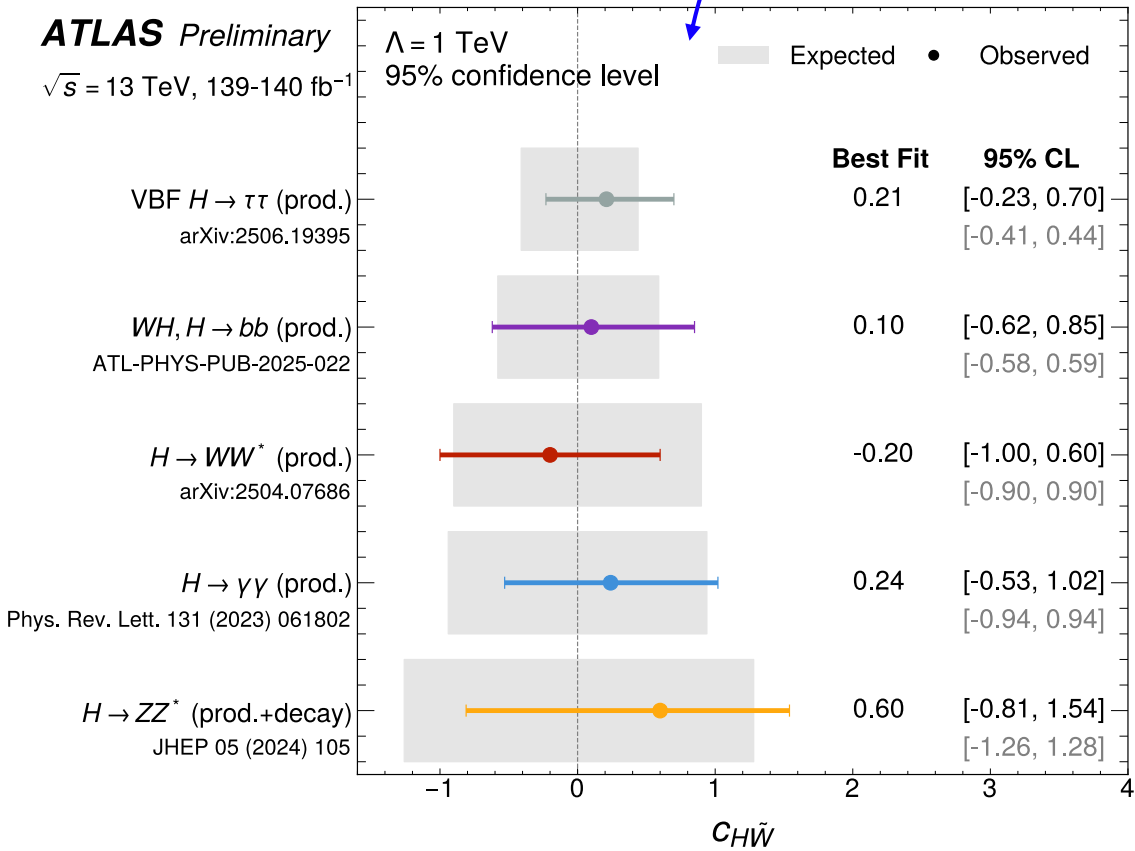
*Dedicated EFT session on Wednesday for CP/EFT-coupling interpretations

Discussion Time

CP-structure just for completeness

Example constraints on CP-odd components in

- H-V couplings
- H-f couplings



More of this kind of comparison plot would be great for EFTs in general