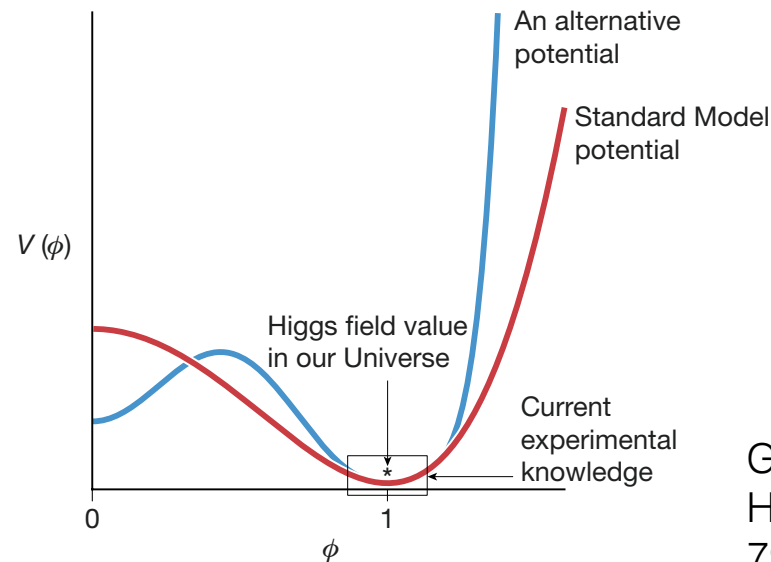


H(125) self-coupling and pair production: overview

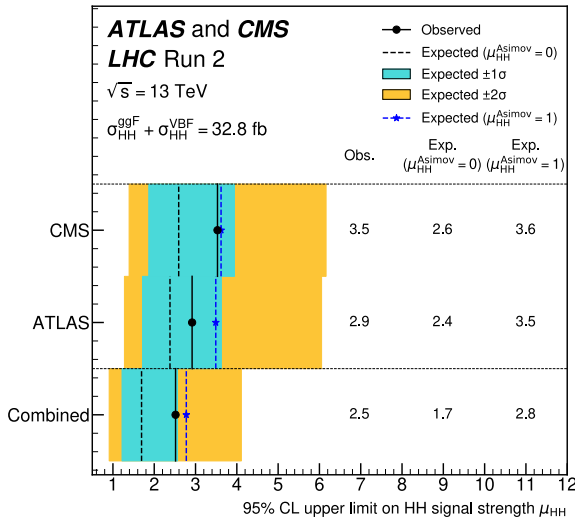
Higgs Hunting 2026 - 16/09/2026

Nicolas Chanon - IP2i Lyon, CNRS/IN2P3 (France)



G. Salam, L.-T. Wang, G. Zanderighi, "The Higgs boson turns ten," Nature 607 (2022) 7917, 41-47

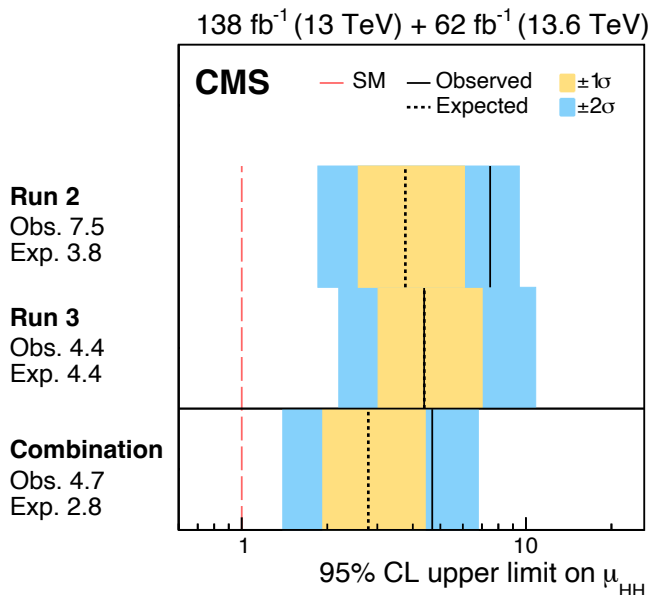
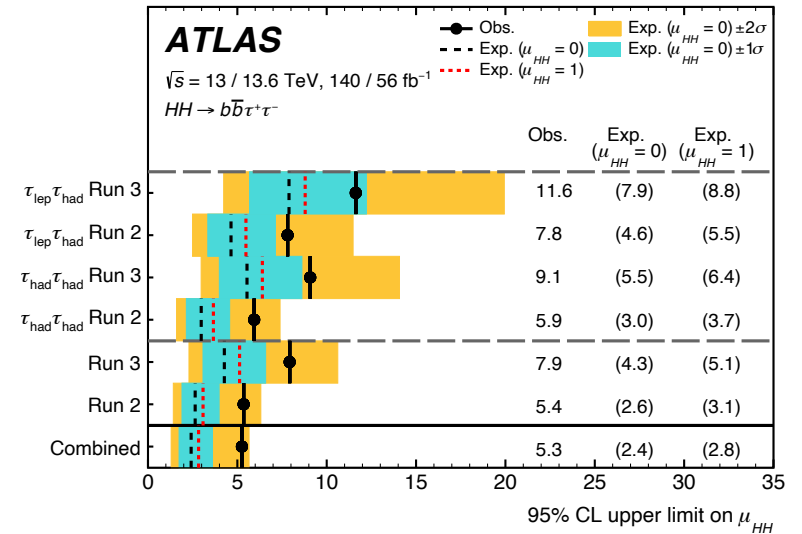
Higgs pair production



ATLAS+CMS HH combination with Run 2 data
 arxiv:2602.23991

ATLAS Run2 + early Run 3 HH $\rightarrow b\bar{b}\tau\tau$, arXiv:2607.26879
 expected sensitivity already reaching that of ATLAS Run 2 combination, thanks to reanalysis of Run 2, trigger, b-tagging and event classifier with transformers...

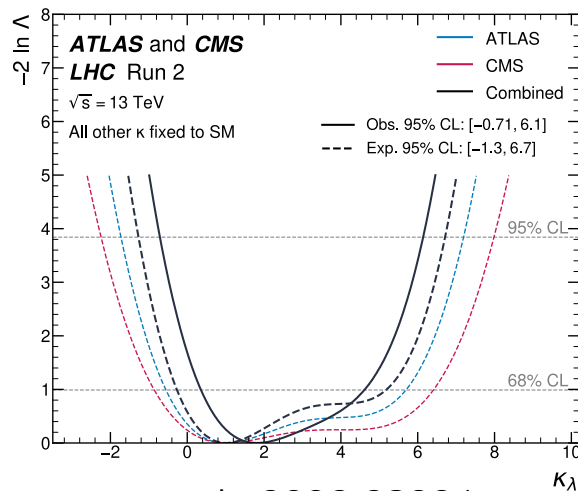
(Only showing most sensitive ATLAS and CMS channels discussed today)



CMS Run2 + early Run 3 HH $\rightarrow bbbb$, arXiv:2604.27044

- With 62 fb-1, 4b achieves a comparable sensitivity with Run 2; Run 2+3 4b almost reaches sensitivity of CMS Run 2 combination
- 30% improvement to Run 2 lumi scaling from trigger, b-jet selection and mass with a global transformer, improved background estimate

H(125) self-coupling



arxiv:2602.23991

- **Partial Run 3 measurements appearing gradually**, and for some of them, along with their **combination with Run 2** data
- Searching for SM HH production, and decreasing the measurement uncertainty on the self coupling
- Run 2 combination still provides the best sensitivity, compared to that of measurements in dedicated channels at Run 2+ partial Run 3

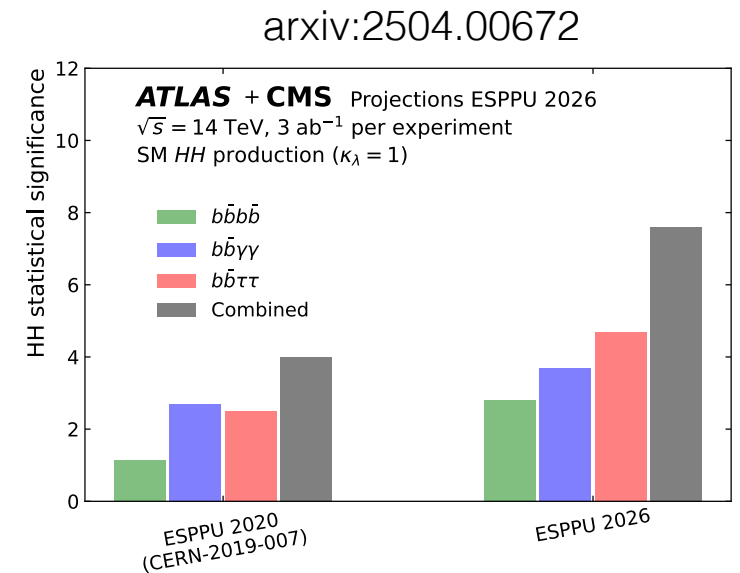
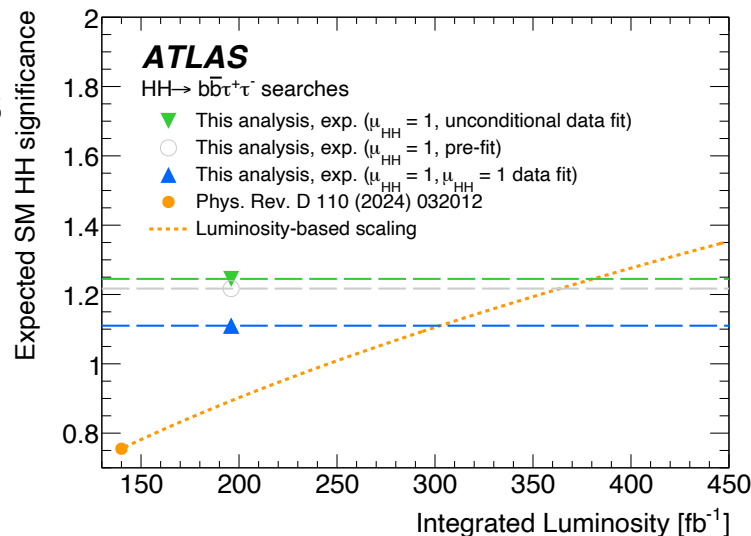
Channel	k_λ 95% CL Observed	k_λ 95% CL Expected	Reference
ATLAS+CMS Comb Run 2	$[-0.71, 6.1]$	$[-1.3, 6.7]$	arxiv:2602.23991
CMS 4b Run 2 + 62 fb-1 Run 3	$[-4.1, 9.6]$	$[-3.2, 9.8]$	arxiv:2604.27044
CMS 2b2 τ Run 2 + 172 fb-1 Run 3	$[-2.5, 9.4]$	$[-1.5, 8.4]$	CMS-PAS-HIG-25-008
CMS 2b2 γ 62 fb-1 Run 3	$[-6.1, 12.8]$	$[-3.6, 10.5]$	CMS-PAS-HIG-25-007
ATLAS bb $\tau\tau$ Run 2 + 56fb-1 Run 3	$[-3.4, 2.6] \cup [5.5, 10.1]$	$[-1.7, 8.5]$	arXiv:2607.26879

- Shown here: the channels measuring k_λ discussed today
- Not shown here: also measuring k_{2V} with Run 3 data,
- **Work towards including full Run 3** is ongoing, e.g. CMS 2b2 τ : 172 fb-1 at 13.6 TeV, including 2024 data
- Expect also results expressed in the EFT framework and in BSM setups.

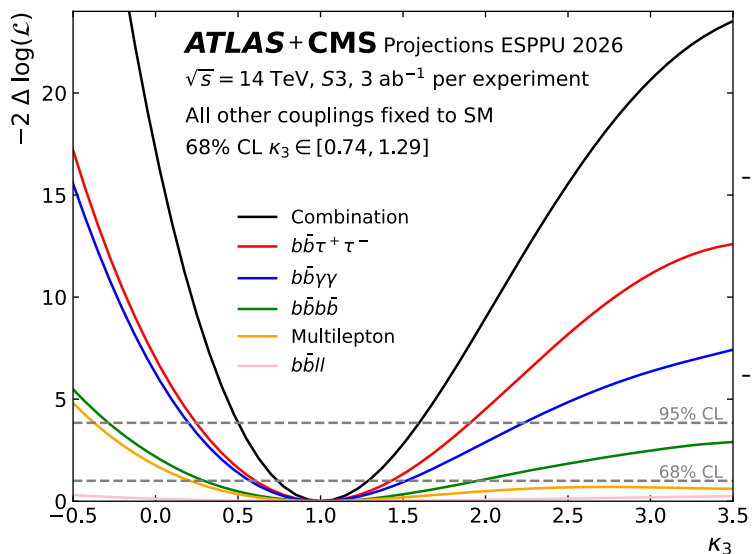
Perspectives on HH and self-coupling

- Improvements exceed by far luminosity scaling.
- We know that this trend will continue in the near future

Example of ATLAS
Run2
+ early Run 3
 $HH \rightarrow b\bar{b}\tau\tau$,
arXiv:2607.26879



HH production: how far are we from an observation with Run 2+3 datasets?



arxiv:2504.00672

The **HL-LHC will be needed** to achieve an evidence on the **H self-coupling**

ATLAS, JHEP 08(2026) 020

Channel	Best fit μ_{tHH}
1L	-5^{+15}_{-15}
SSML	5^{+17}_{-21}
$b\bar{b}\gamma\gamma$	-13^{+35}_{-6}
Combination	-3^{+11}_{-12}

- Lower cross section channels such as $t\bar{t}HH$, unique for dedicated EFT sensitivity, will also be interesting

Discussion