



# “Three” slides of comparison for HH

**Elizabeth Brost**, based on talks by Zhe Yang ([ATLAS](#)) and Marcel Rieger ([CMS](#))  
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HHiggs HHunting 2022, Orsay/Paris



# Higgs Hunting

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**International Address**

[illegible]

**La Jeune Fille à la perle**  
*Johannes Vermeer, 1665*

12<sup>TH</sup> HIGGS HUNTING

[www.higgshunting.fr](http://www.higgshunting.fr)

Elizabeth Brost - HHiggs HHunting 2022

- **Size of HH cross section at the LHC?**
- **Strength of Higgs self-coupling?**
- **Other HH-centric couplings ( $\kappa_{2V}$ )?**



# Limits - $\sigma^{HH}/\sigma^{HH}_{SM}$

ATLAS:  $\sigma/\sigma_{SM} < 2.4$  (2.9), obs (exp)

CMS:  $\sigma/\sigma_{SM} < 3.4$  (2.5), obs (exp)

	bb	WW	$\tau\tau$	ZZ	YY
bb	34%				
WW	25%	4.6%			
$\tau\tau$	7.3%	2.7%	0.39%		
ZZ	3.1%	1.1%	0.33%	0.069%	
YY	0.26%	0.10%	0.028%	0.012%	0.0005%

41 (29)  
PLB 801 (2020) 135145

30 (37)  
CMS-PAS-HIG-20-004

22 (20)  
CMS-PAS-HIG-21-002

5.4 (8.1)  
ATLAS-CONF-2022-035

3.9 (7.8)  
arXiv:2202.09617

9.9 (5.1)  
CMS-PAS-B2G-22-003

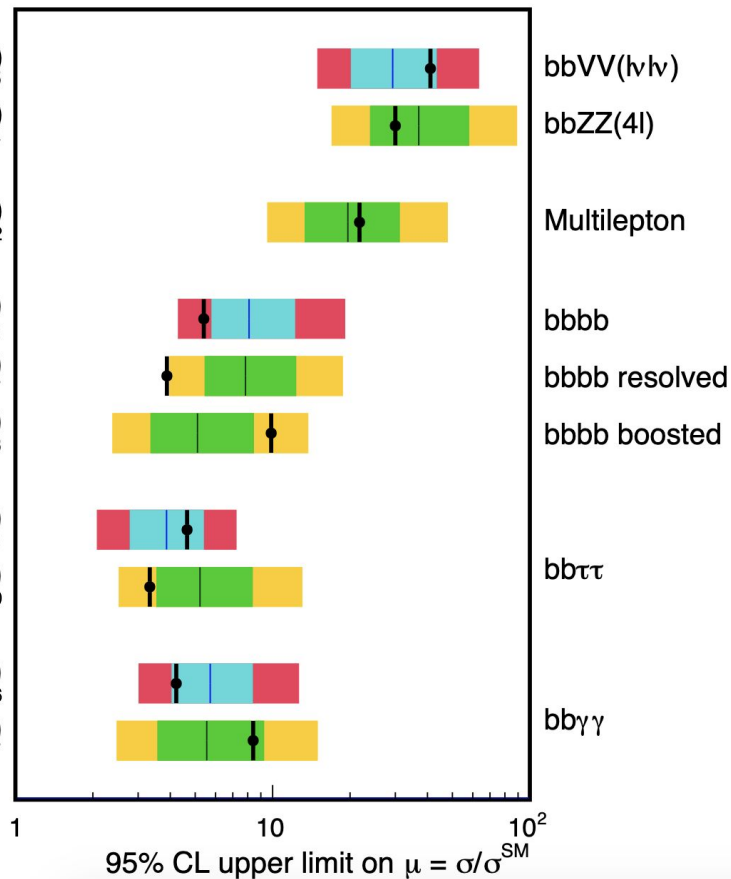
4.7 (3.9)  
ATLAS-CONF-2021-030

3.3 (5.2)  
CMS-PAS-HIG-20-010

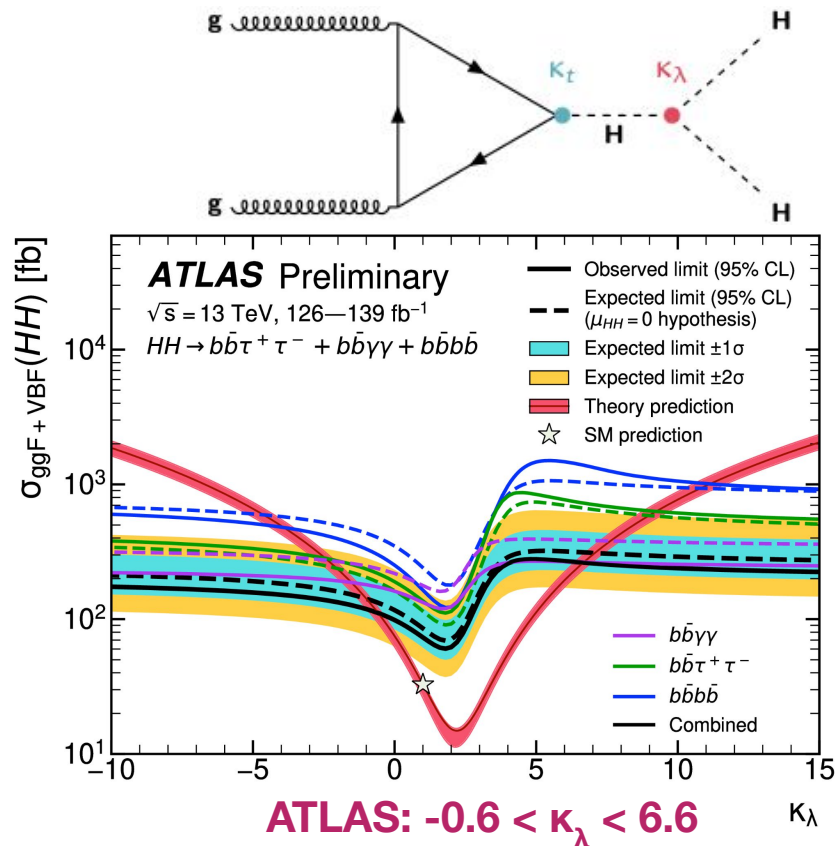
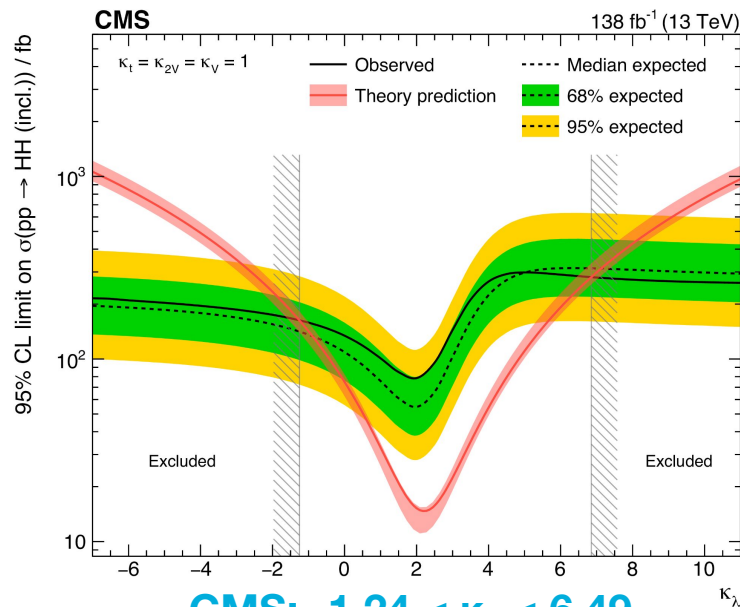
4.2 (5.7)  
arXiv:2112.11876

8.4 (5.5)  
JHEP 03 (2021) 257

ATLAS CMS

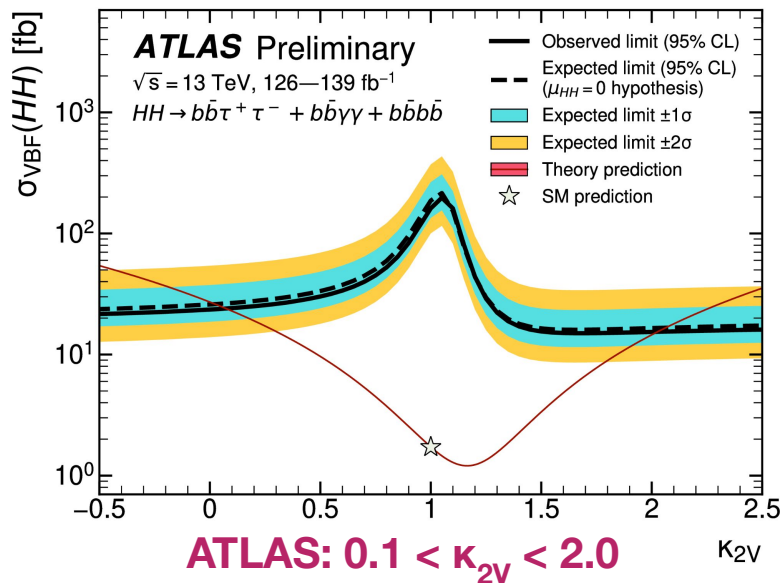
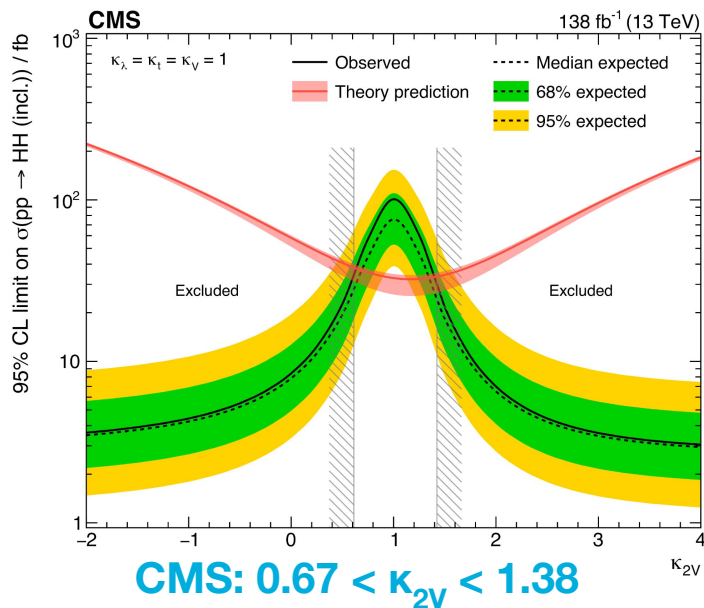
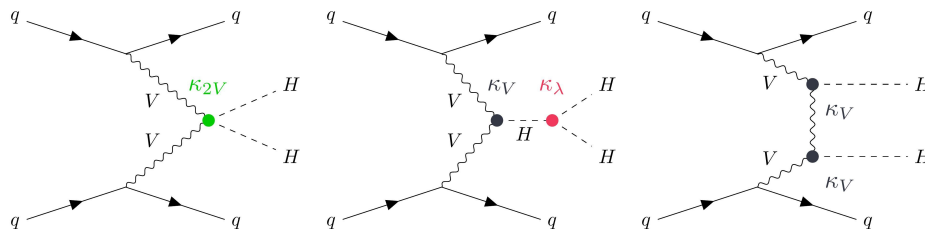


# Higgs self-coupling



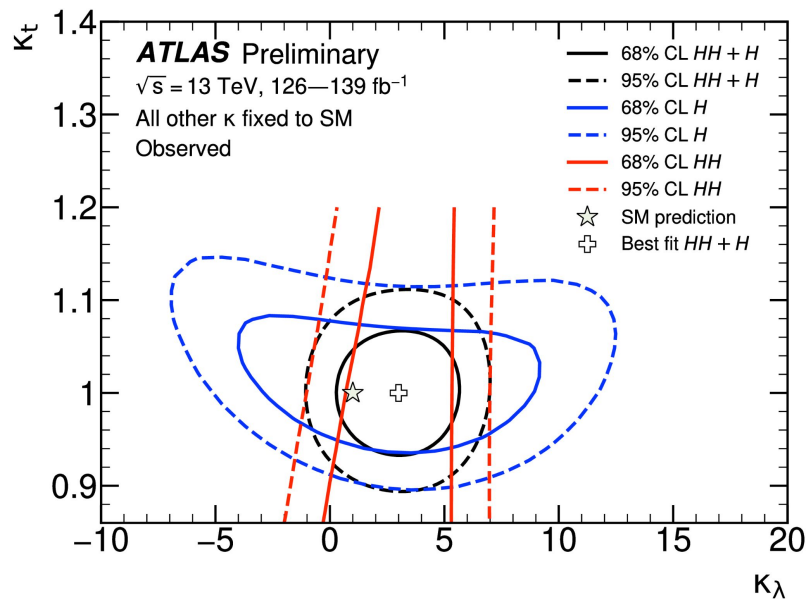
**Need low- $p_T$  events  $\rightarrow$  future trigger improvements?**

# HHVV coupling



**CMS reports  $\kappa_{2V} \leq 0$  excluded @ 6.6 $\sigma$  assuming all other couplings are SM-like**

# HH & friends



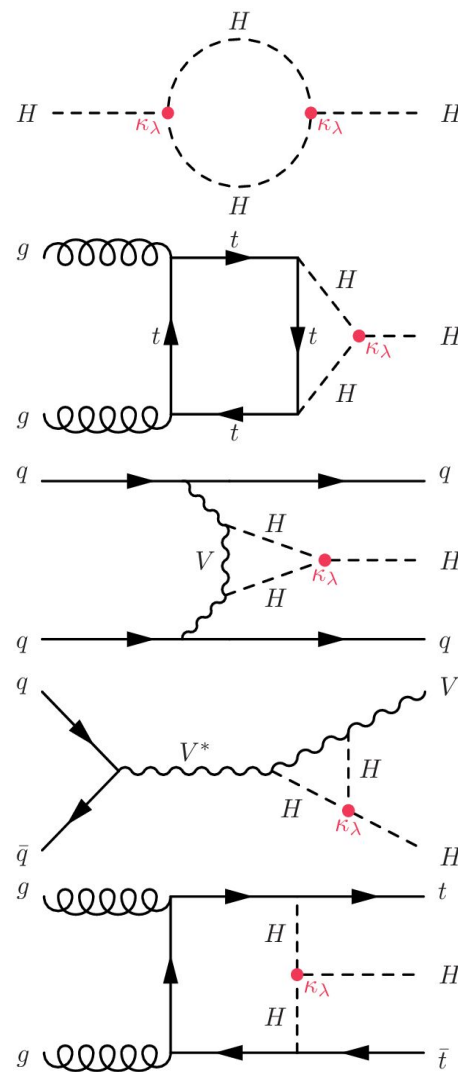
Next step: Add  
 HH to global  
 EFT fits?

Compare to  
 $-0.6 < \kappa_\lambda < 6.6$   
 for HH only

Profile  $\kappa_\lambda$  only:  $-0.4 < \kappa_\lambda < 6.3$  (95% CL)

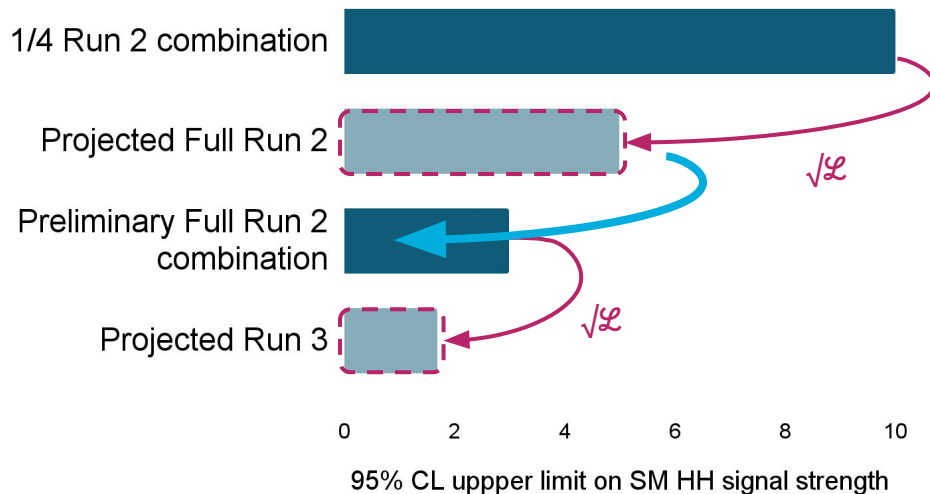
Profile  $\kappa_\lambda, \kappa_t, \kappa_V, \kappa_b, \kappa_\tau$ :  $-1.3 < \kappa_\lambda < 6.1$  (95% CL)

See [Alkaid's talk](#) for more details





# What can we do with Run 3?



We've already seen a factor of  $\sim 1.7$  improvement due to improved reconstruction and analysis techniques in full Run 2 dataset (compared to simple projection based on  $\sqrt{\mathcal{L}}$ )

SM expectation within reach for Run 3 limits if we:

- Continue the same pace of analysis improvements, or
- Combine ATLAS+CMS results

# What can we do with Run 3?

- Looking forward to Run3 and future HL-LHC programs to increase the data sets to probe the Higgs potential structure with much better sensitivity
    - Run 3: factor of  $\sim 3$
    - HL-LHC: factor of  $\sim 20$
  - EFT interpretations and resonant HH searches on the horizon
  - Exciting years ahead!
- 1/4 Run 3
- projected Run 3
- $\sqrt{s}$
- Z. Yang, HHiggs HHunting 2022
- (compared to simple
- based on  $\sqrt{s}$ )
- M. Rieger, HHiggs HHunting 2022
- improvements, or
  - Combine ATLAS+CMS results



# Backup

# Limits - $\sigma^{HH}/\sigma^{HH}_{SM}$

