

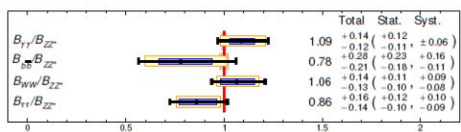
**Summary**  
**Stronger together:**  
Combined measurements of Higgs boson  
production and decays with the ATLAS detector

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on behalf of the ATLAS collaboration

Higgs 2021  
October 21, 2021

**Combinations** of the individual Run-2 measurements allow to provide the **most precise measurements and most stringent constraints** on BSM modifications with **minimal assumptions**

- **Combined measurements of Higgs-boson production and decay** ([ATLAS-CONF-2021-053](#))
  - See also [Q. Buat's talk](#)
  - **New for Higgs 2021**  $\Rightarrow$  **Focus of the talk**
  - No discussion of EFT interpretation  $\rightarrow$  see [C. Burgard's talk](#) and [M. Battaglia's talk](#)
- **VH,  $H \rightarrow bb$  combination** ([ATLAS-CONF-2021-051](#))
  - See also [MG. Foti's talk](#)
- **Combination of searches for invisible Higgs-boson decays** ([ATLAS-CONF-2020-052](#))
  - See also [S. Snyder's talk](#)
- **Combined (differential) cross-section measurement of  $H \rightarrow \gamma\gamma$  and  $H \rightarrow ZZ^* \rightarrow 4l$**  ([ATLAS-CONF-2019-032](#))



Combined measurements of Higgs boson production and decay using up to  $139 \text{ fb}^{-1}$  of proton-proton collision data at  $\sqrt{s} = 13 \text{ TeV}$  collected with the ATLAS experiment

### STXS measurement

- Most granular to date (stage 1.2): new kinematic regions for all main production modes

- Updates to the full Run-2 dataset ( $H \rightarrow WW^*/\tau\tau$ , VBF/ttH  $H \rightarrow bb$ )
- New channels (VH/ttH  $H \rightarrow \tau\tau$ ,  $H \rightarrow Z\gamma$ )
- Analysis improvements (MVA, STXS-like categorisation,..)

### Interpretation: $\kappa$ framework

- Model-independent, several scenarios
- Probing BSM contribution in loops only  $\rightarrow$  effective coupling strength modifiers
- New:  $Z\gamma$  - obs. (exp.) sign.:  $2.2 (1.1) \sigma$

$$\kappa_g = 1.00 \pm 0.05$$

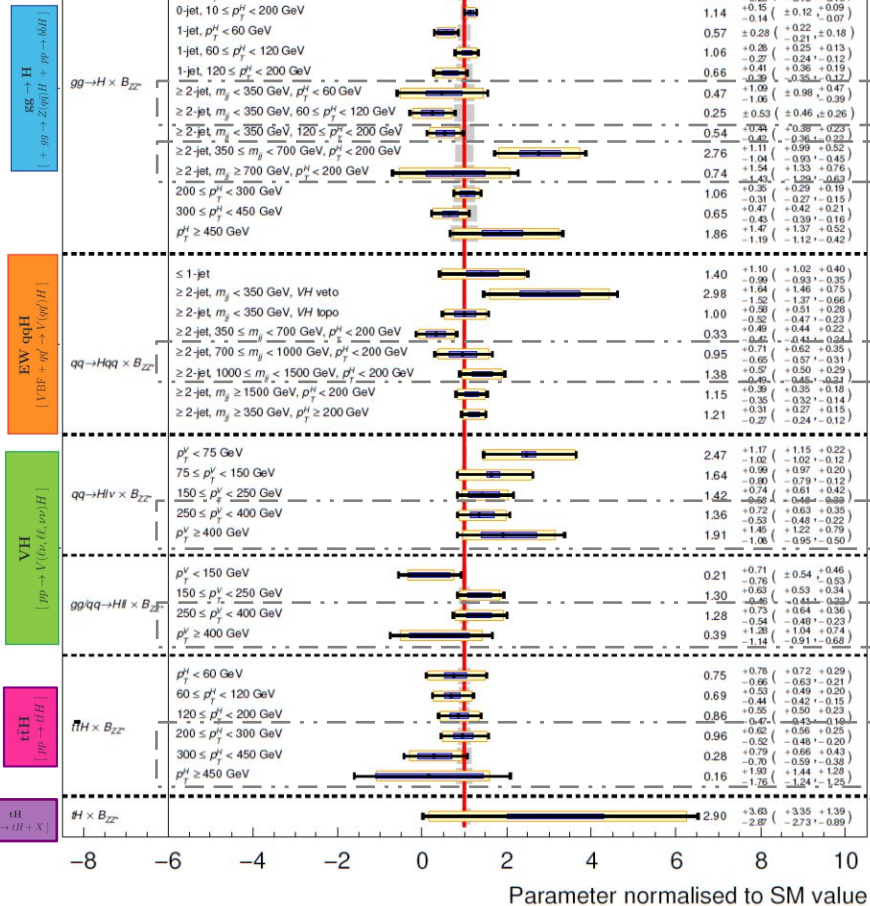
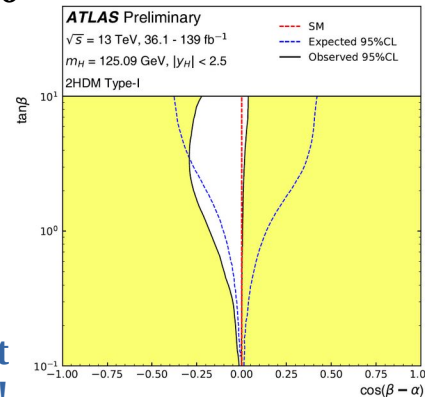
$$\kappa_\gamma = 1.06 \pm 0.05$$

$$\kappa_{Z\gamma} = 1.43^{+0.31}_{-0.38}$$

### Interpretation: 2HDM

- Model-dependent, four types
- Data consistent with alignment limit within  $\leq 1\sigma$

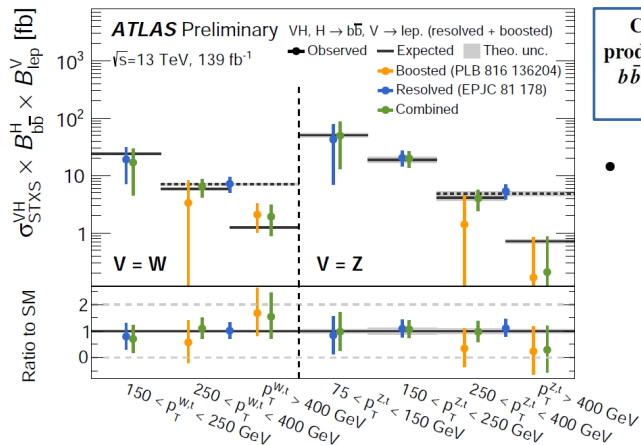
All results are in very good agreement with the SM prediction!



New splits

## VH, H → bb resolved+boosted combination

ATLAS-CONF-2021-051

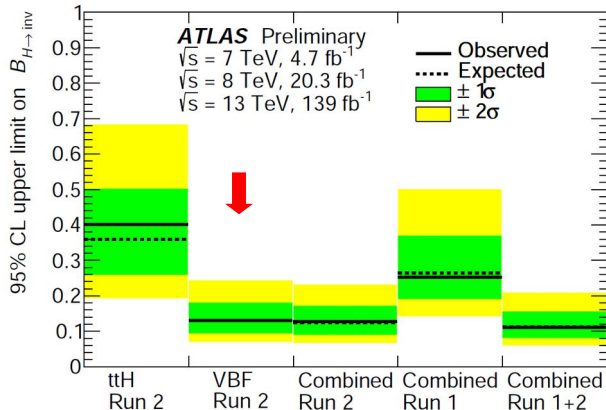


Combination of measurements of Higgs boson production in association with a W or Z boson in the  $b\bar{b}$  decay channel with the ATLAS experiment at  $\sqrt{s} = 13$  TeV

- 7-bin VH STXS measurement

## Partial Run 2 (+ Run 1) H → inv. combination

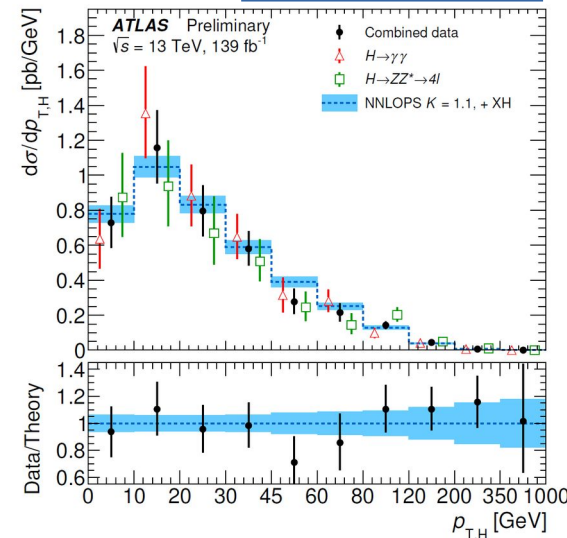
ATLAS-CONF-2020-052



Combination of searches for invisible Higgs boson decays with the ATLAS experiment

- Obs. limit on BR( $H \rightarrow \text{inv.}$ ): 11%
- Run 2 VBF,  $H \rightarrow \text{inv.}$  driving limit
- New potential inputs ready, e.g Z( $ll$ )H

ATLAS-CONF-2019-032



Combined measurement of the total and differential cross sections in the  $H \rightarrow \gamma\gamma$  and the  $H \rightarrow ZZ^* \rightarrow 4l$  decay channels at  $\sqrt{s} = 13$  TeV with the ATLAS detector

- ~20% precision per bin (except highest bin)
- Stat. limited