

ATLAS-NL group  
6 September 2019  
Staff Meeting at Nikhef

# NEW ATLAS RESULTS



**ATLAS**  
EXPERIMENT

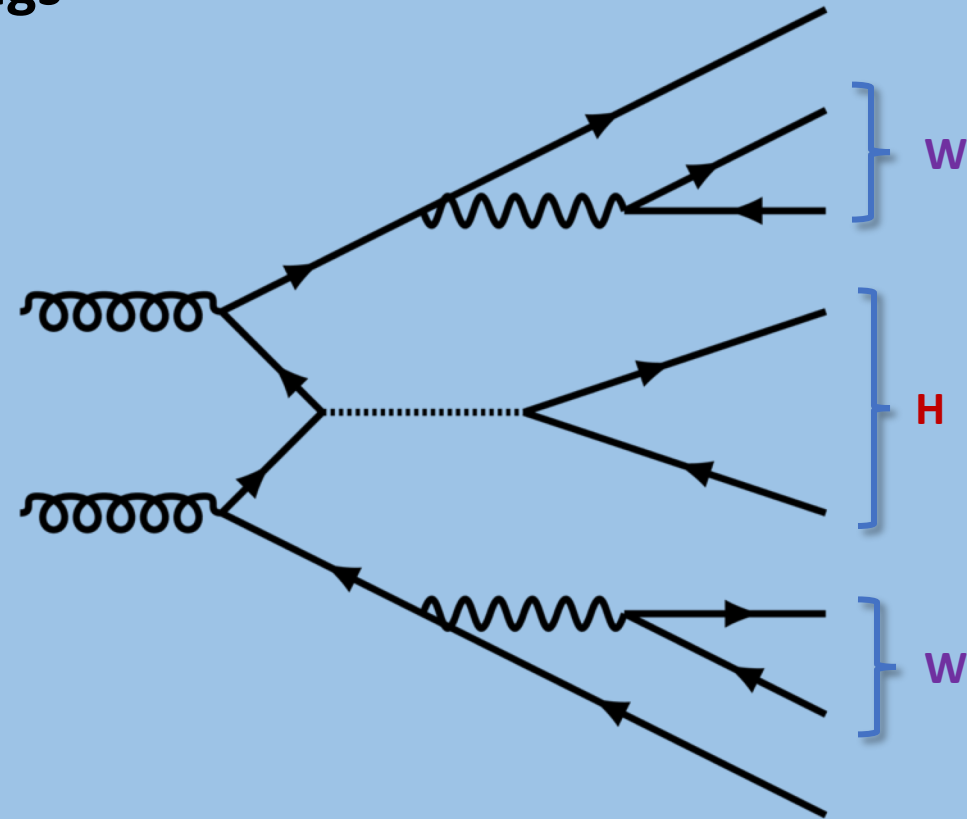
# ttH

- **2018: Year of the Higgs-quark couplings**

- ttH: direct probe of top-Higgs coupling

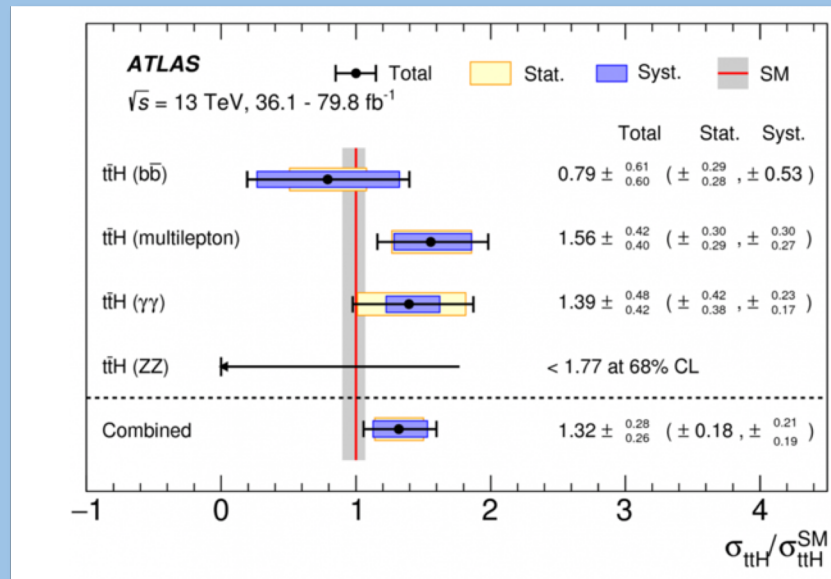
- **Various final states**

- **Higgs decays**  
bb &  $\gamma\gamma$  & WW & ZZ &  $\tau\tau$
- **W decays:**  
leptonic, hadronic, semi-leptonic



# ttH

- **2018: ttH**
  - Observe top-Higgs coupling
- **Various decays**
  - Higgs:  $bb/\gamma\gamma/WW/ZZ/\tau\tau$
  - $t/W$ : hadronic, (semi-)leptonic
- **New ttH combination**
  - $5\sigma$  at last! (incl.  $H \rightarrow bb$ )
- **Large contribution from Amsterdam/Nijmegen**
  - Tim Wolf + Snezana Nektarijevic + Luca Colasurdo + Frank Filthaut + Nicolo de Groot + Pamela Ferrari

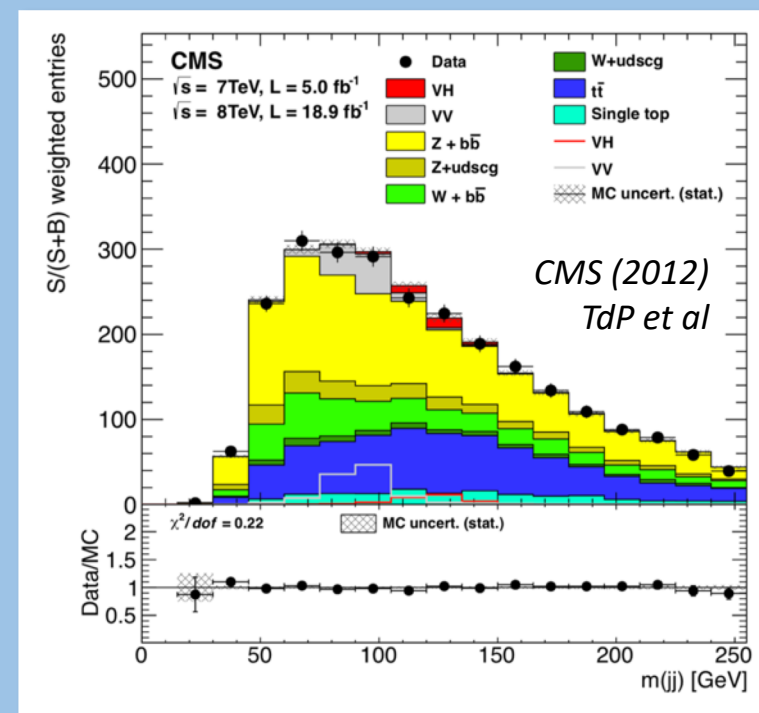


*Tim Wolf*  
*PhD defense Dec. 2018*

➤ <https://www.nikhef.nl/nieuws/higgs-koppelt-aan-materiedeeltje-topquark/>

# H → bb

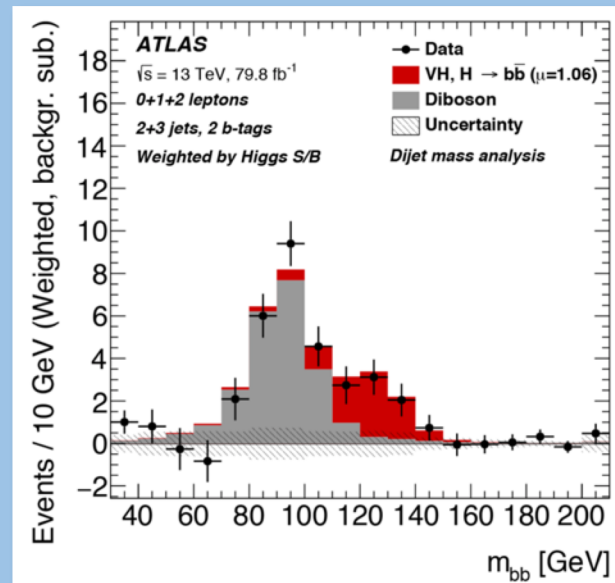
- **2018: Year of the Higgs-quark couplings**
  - Probe of bottom-Higgs coupling
- **Large BR (58%)**
  - Dominant part of width in SM
- **Challenging due to backgrounds**
  - Only  $\sim 2\sigma$  sensitivity in Run-1





# H → bb

- **2018: observation of H → bb!**
  - 5 $\sigma$  sensitivity to bottom-Higgs coupling
- **Large BR (58%)**
  - Dominant part of width in SM
- **Challenging due to backgrounds**
  - Advanced analysis techniques
  - Selection, MVAs, **b-jet identification**, dijet mass resolution, **multidimensional fits**
- **All charged 3<sup>rd</sup>-generation Higgs-fermion couplings observed**



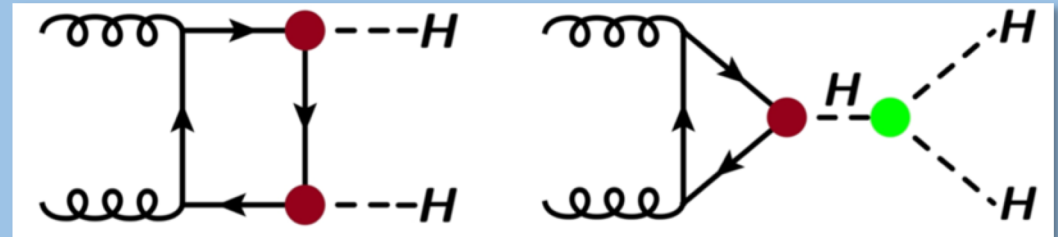
Hannah Arnold (postdoc)

➤ <https://www.nikhef.nl/nieuws/long-sought-decay-of-higgs-boson-observed/>

# HH

- **Double Higgs production challenging**

- Small cross-section (33 fb)
- Destructive interference

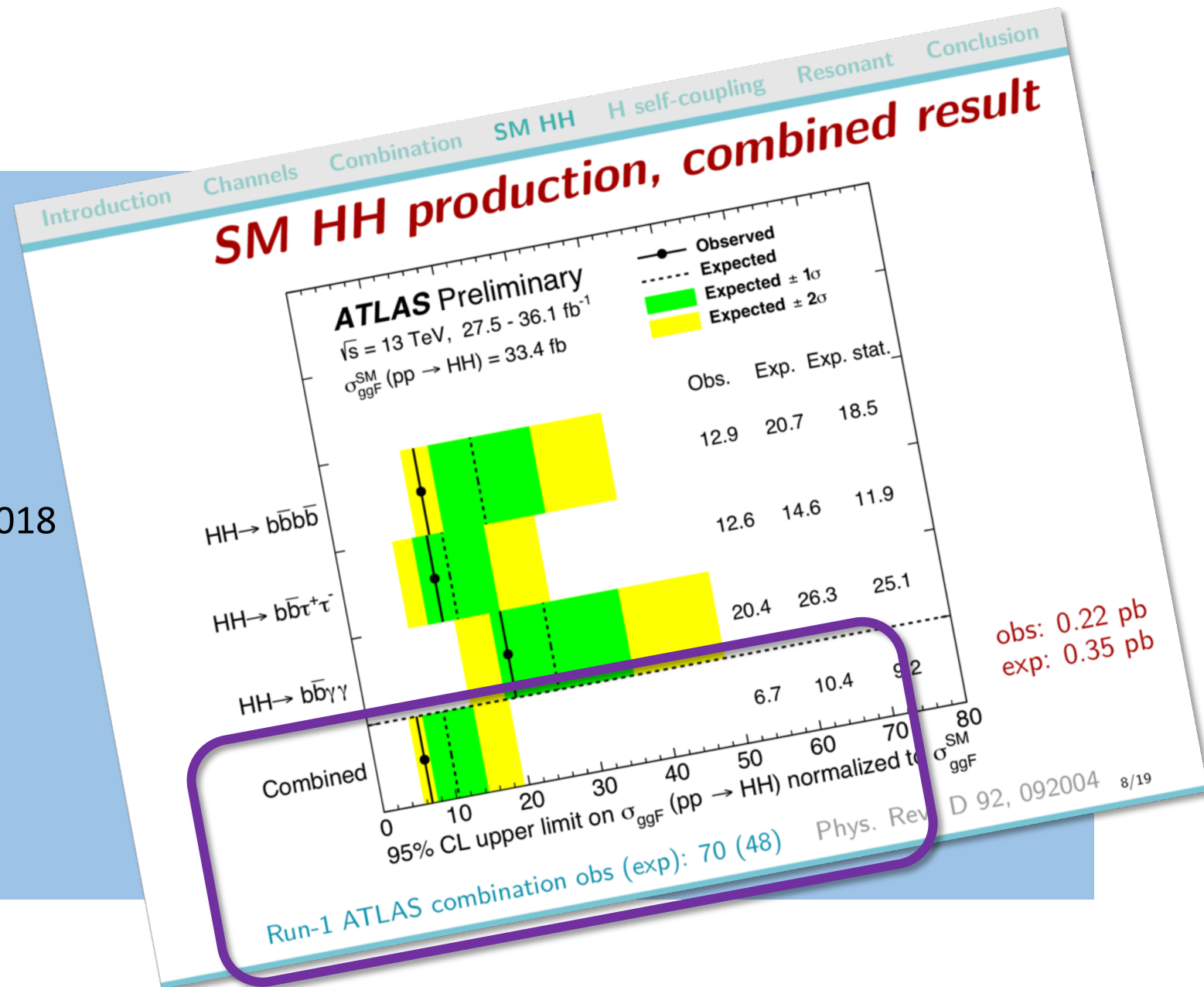


- **One of the main goals of HL-LHC**

- Fundamental for the understanding of the Higgs potential, self coupling
- **Conservative projections foresee  $2\sigma$  per experiment at the LHC**

# HH

- **HH challenging**
  - Small cross-section
  - Destructive interference
- **New result**
  - This week at Higgs Hunting 2018
    - **Obs: 6.7 x SM**
    - **Exp: 10.4 x SM**
  - Note comparison with Run-1 sensitivity
    - **Exp: 48 x SM**



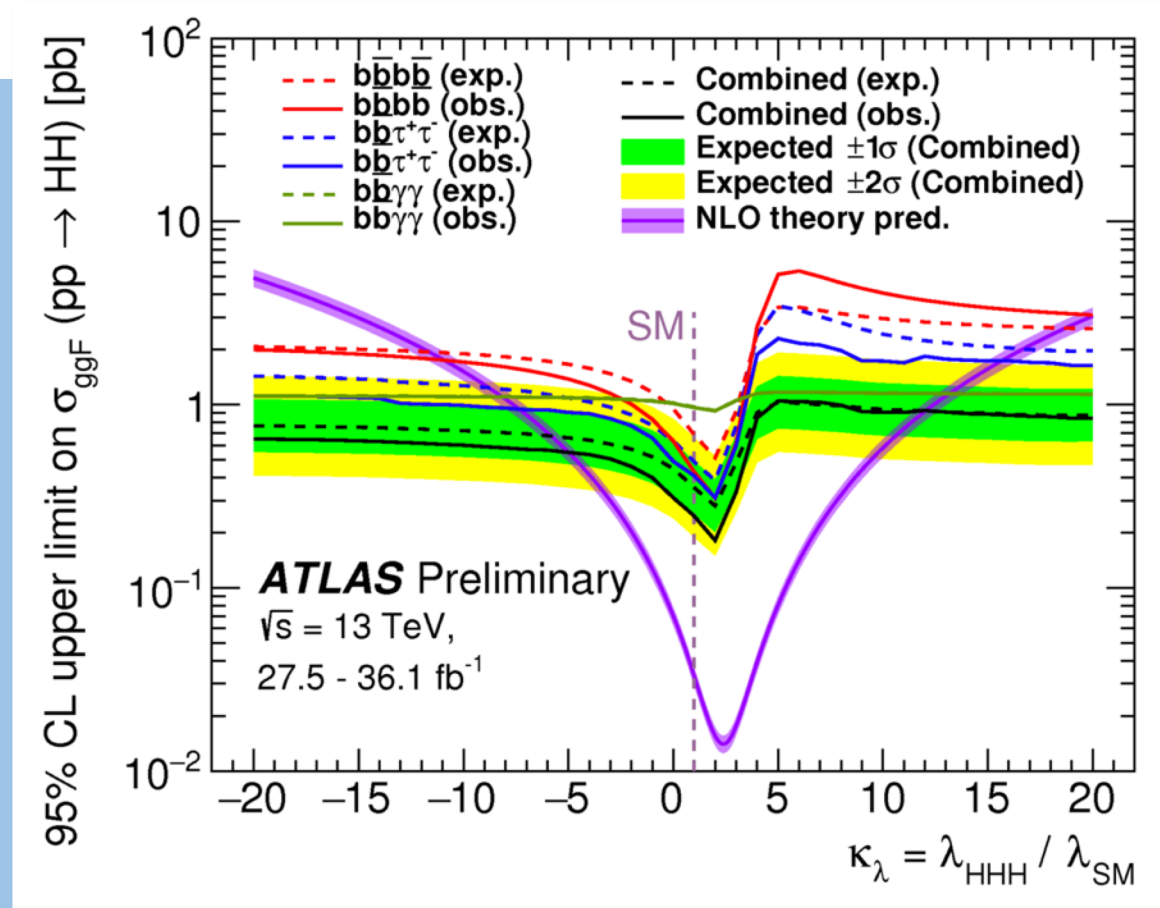
# HH

## • HH challenging

- Small cross-section
- Destructive interference

## • New result

- This week at Higgs Hunting 2018
  - **Obs: 6.7 x SM**
  - **Exp: 10.4 x SM**
- Self coupling constraint
  - **$-5.0 < \kappa_\lambda < 12.1$**



➤ Next round: Pamela Ferrari, Bob van Eijk + 1 postdoc + 1 student



# ATLAS IN NATURE



# LAST SLIDE

- Sascha in Nature

A screenshot of a web browser displaying a news article on the Nature website. The page features a red header with the 'nature' logo and navigation links. The article title is 'LHC physicists embrace brute-force approach to particle hunt', dated 14 August 2018. The author is Davide Castelvecchi. Below the text is a large photograph of the LHC tunnel interior, showing a person standing on a yellow platform. To the right of the photo are links for 'PDF version' and 'RELATED ARTICLES', including 'China, Japan, CERN: Who will host the next LHC?' and 'Particle physicists turn to AI to cope with CERN's collision deluge'.

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The world's most powerful particle collider has yet to turn up new physics – now some physicists are turning to a different strategy.

Davide Castelvecchi

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