

# Updated ttH cross sections

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on behalf of Malgorzata Worek, Josh McFayden, Sergio Sanchez Cruz  
(ttH conveners)





# Updated Cross Sections

(Thanks Malgorzata for xcheck!)

- Use the YR4 values to provide interpolated predictions for Higgs sections
  - ttH: NLO QCD + EW [arXiv:1504.03446](https://arxiv.org/abs/1504.03446)

13.6 TeV	$\sigma$ [pb]	$\Delta$ sc [%]	$\Delta$ PDF+ $\alpha_s$	$\Delta$ PDF	$\Delta$ $\alpha_s$
125.0	5.700e-01	+6/-9.3	$\pm 3.5$	$\pm 3$	$\pm 2$
125.09	5.688e-01	+6/-9.3	$\pm 3.5$	$\pm 3$	$\pm 2$
125.38	5.638e-01	+6/-9.3	$\pm 3.5$	$\pm 3$	$\pm 2$

- tH t/s channel: NLO QCD (with FS uncertainty for t-channel) [arXiv:1504.00611](https://arxiv.org/abs/1504.00611)

13.6 TeV	$\sigma$ [pb]	$\Delta$ sc [%]	$\Delta$ PDF+ $\alpha_s$	$\Delta$ PDF	$\Delta$ $\alpha_s$
125.0	8.362e-02	+6.5/-14.8	$\pm 3.7$	$\pm 3.5$	$\pm 1.2$
125.09	8.353e-02	+6.5/-14.8	$\pm 3.7$	$\pm 3.5$	$\pm 1.2$
125.38	8.320e-02	+6.5/-14.8	$\pm 3.7$	$\pm 3.5$	$\pm 1.2$
125.0	3.068e-03	+2.4/-1.7	$\pm 2.2$	$\pm 2.2$	$\pm 0.3$
125.09	3.064e-03	+2.4/-1.7	$\pm 2.2$	$\pm 2.2$	$\pm 0.3$
125.38	3.052e-03	+2.4/-1.7	$\pm 2.2$	$\pm 2.2$	$\pm 0.3$

- tHW: (no interpolation performed at the moment, only 1  $m_H$  available) NLO QCD [arXiv:1607.05862](https://arxiv.org/abs/1607.05862)  
To be recomputed  
(What parameters were employed for the reference numbers?)

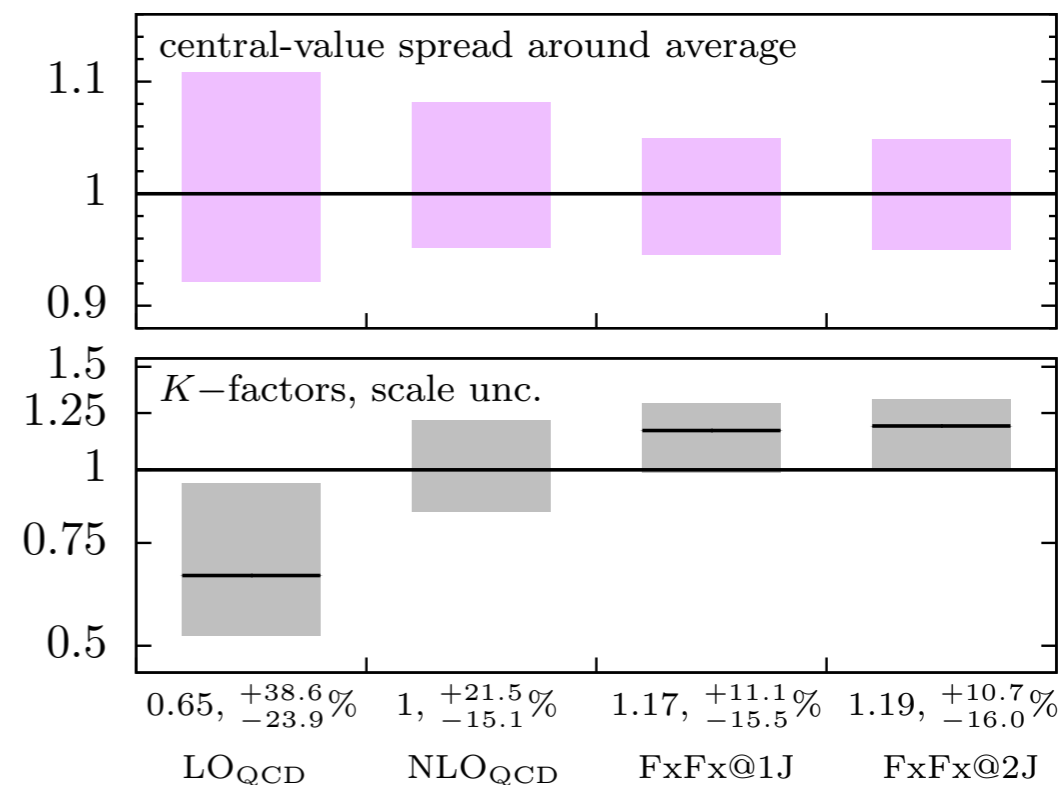


# New reference predictions

- Since YR4, results including NNLL soft resummation appeared for  $ttH$  (and  $ttW/Z$ ), combined with NLO EW / Complete NLO corrections
  - [arXiv:1907.04343](#)  
**Top-quark pair hadroproduction in association with a heavy boson at NLO+NNLL including EW corrections**  
[Alessandro Broggio, Andrea Ferroglia, Rikkert Frederix, Davide Pagani, Benjamin D. Pecjak, Ioannis Tsinikos](#)
  - [arXiv:2001.03031](#)  
**Associated top quark pair production with a heavy boson: differential cross sections at NLO+NNLL accuracy**  
[Anna Kulesza, Leszek Motyka, Daniel Schwartzländer, Tomasz Stebel, Vincent Theeuwes](#)
- Same fixed-order prediction, different resummation methodology
- Both groups have confirmed their availability to provide updated predictions

# $tt+V$

- $ttZ$ : upgrade reference prediction including NNLL resummation (like  $ttH$ )
- $ttW$ :
  - $t$ - $W$  scattering contribution (complete-NLO) on top of NLO EW ( $\sim 10\%$  effect) [arXiv:1711.02116](#)
  - Resummation has tiny effect (do not include)
  - Include higher multiplicities in reference xsection using updated FxFx merging scheme ( $\sim 20$ - $30\%$  effect) [arXiv:2108.01726](#)
- How about  $tt$ +photon(s)?





# ttH WG: The road ahead

- Study the modelling issues of the signal and backgrounds
  - ttbb (complete the ongoing work started long ago)
  - ttW
  - ttZ
  - tt+photons
- Dedicated meetings will be announced shortly
- For contributions and/or suggestion, please contact us!