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Updated cross sections for $t\bar{t}H$ and tH production

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Abstract: New reference cross sections are presented.

Contents

We report on the calculation of the updated reference cross sections for $t\bar{t}H$ and tH production. Parameters and setups are chosen according to https://twiki.cern.ch/twiki/bin/view/LHCPhysics/LHCHWG136TeVxsec

1 $t\bar{t}H$

Known radiative corrections for $t\bar{t}H$ production at hadron colliders include NLO QCD corrections [? ? ?], NLO EW [? ? ?] and complete NLO [?] preictions, as well as predictions beyond NLO QCD, where higher-order effects are either included via soft-gluon resummation, known up to NNLL [? ? ? ?], or by considering NNLO corrections with an approximation of the (still unknown) two-loop amplitude [?]. We will refer to the latter as approximate-NNLO (aNNLO). Predictions obtained via resummation have been combined with the complete-NLO prediction [? ? ?].

In the presentation of results, we will use the following labels for the different groups providing the results:

I: Ref. [?] (Broggio et al.). The results have been obtained using the same calculation framework of Ref. [?] with the recommended input parameters. Predictions are therefore accurate at Complete-NLO accuracy, meaning all the QCD and EW perturbative orders stemming from tree-level and one-loop diagrams, matched to soft gluon emission corrections resummed to NNLL accuracy. We stress that the theory uncertainty has been obtained by combining two different dynamical-scale choices, as described in Ref. [?]. In particular, these two choices for the central scale are

$$\mu_0^{(1)} = \frac{H_T}{2}\,, \qquad \mu_0^{(2)} = \frac{m(t\bar{t}H)}{2}\,. \tag{1.1}$$

The choice $\mu_0^{(1)}$ is employed for the central value of the predictions, while the scale-uncertainty band is evaluated by considering the envelope of the nine-point variations (by a factor 2 up/down) **MZ CHECK!!** obtained with the two choice around the respective central value.

Besides the input parameters, there is an other difference with Ref. [**?**]. Since results depend on the photon PDF, not provided by the recommended PDF set (PDF4LHC21_40), the following combination has been performed: the Complete-NLO prediction computed with the aforementioned set has been reweighed with the ratio of the Complete-NLO prediction obtained with LUXqed17_plus_PDF4LHC15_nnlo_100 over the same prediction where the photon PDF has been set to zero. The corrections from the NNLL resummation have not been rescaled. We note that the impact of the photon PDF is about 0.68% on the final result.

II: Refs. [**? ?**] (Kulesza et al.). Scale setting:

$$\mu_F = \mu_R = H_T/2\,. \tag{1.2}$$

Scale uncertaintities: seven point method, i.e. maximal and minimal values of the seven combinations

$$\left(\frac{\mu_F}{\mu_0}, \frac{\mu_R}{\mu_0}\right) = (0.5, 0.5), (0.5, 1), (1, 0.5), (1, 1), (1, 2), (2, 1), (2, 2) \tag{1.3}$$

around the central value $\left(\frac{\mu_F}{\mu_0}, \frac{\mu_R}{\mu_0}\right) = (1, 1)$.
EW scheme for corrections: G_μ scheme.
Pdfs: PDF4LHC21_40_pdfas [] for QCD-initiated channels and LUXqed17_plus_PDF4LHC15_nnlo_100 [] for the photon-initiated channels.

Inclusion of photon corrections: photon-initiated channels are included at NLO (output from aMC@NLO for these channels run with LUXqed17_plus_PDF4LHC15_nnlo_100 pdfs)

III: Ref. [**?**] (Catani et al.). Numbers are computed at the aNNLO QCD + complete-NLO accuracy. **MZ preliminary numbers do not include photonic contributions**. The QCD scale uncertainties refer to a 7-point variation around the central scale

$$\mu_F = \mu_R = H_T/2\,, \tag{1.4}$$

but symmetrized by understanding the maximal deviation from the central-scale prediction among the 7-point variation points as the QCD scale uncertainty applied in both directions. The theoretical uncertainty contains the uncertainty due to the soft-Higgs approximation that we apply for the 2-loop amplitudes as well as statistical integration uncertainties and the uncertainty due to the $r_{\rm cut} \to 0$ extrapolation in our q_T-slicing approach; it is, however, always dominated by the soft-approximation uncertainty.
Results for a set of different functional forms for the central scale are also presented in Tab. **??**.

The fixed-order part of I, II is computed using MadGraph5_aMC@NLO [**? ?**].

		$\mu = \frac{m_H}{2} + m_t$			$\mu = \sum_{t,\bar{t},H} \frac{E_T}{2}$			$\mu = \frac{H_T}{2}$			$\mu = \frac{m(t\bar{t}H)}{2}$		
$\sqrt{s}$ [TeV]	m_H [GeV]	σ [fb]	$\delta_\mu + \delta_{\rm ThU}$	$\delta_{\rm PDF}$	σ [fb]	$\delta_\mu + \delta_{\rm ThU}$	$\delta_{\rm PDF}$	σ [fb]	$\delta_\mu + \delta_{\rm ThU}$	$\delta_{\rm PDF}$	σ [fb]	$\delta_\mu + \delta_{\rm ThU}$	$\delta_{\rm PDF}$
13.0	124.60	532.0	$^{+3.1}_{-3.1} \pm 0.6$	2.3	527.6	$^{+4.3}_{-4.3} \pm 0.6$	2.3	503.8	$^{+4.1}_{-4.1} \pm 0.7$	2.3	523.0	$^{+4.6}_{-4.6} \pm 0.6$	2.3
13.0	125.00	528.4	$^{+3.2}_{-3.2} \pm 0.7$	2.3	523.8	$^{+4.4}_{-4.4} \pm 0.6$	2.3	500.5	$^{+4.2}_{-4.2} \pm 0.7$	2.3	519.1	$^{+4.7}_{-4.7} \pm 0.6$	2.3
13.0	125.09	526.6	$^{+3.1}_{-3.1} \pm 0.7$	2.3	522.2	$^{+4.4}_{-4.4} \pm 0.6$	2.3	499.0	$^{+4.2}_{-4.2} \pm 0.7$	2.3	517.7	$^{+4.6}_{-4.6} \pm 0.6$	2.3
13.0	125.38	522.7	$^{+3.1}_{-3.1} \pm 0.7$	2.3	518.6	$^{+4.4}_{-4.4} \pm 0.7$	2.3	495.1	$^{+4.1}_{-4.1} \pm 0.7$	2.3	514.1	$^{+4.6}_{-4.6} \pm 0.6$	2.3
13.0	125.60	519.9	$^{+3.1}_{-3.1} \pm 0.7$	2.3	515.5	$^{+4.3}_{-4.3} \pm 0.6$	2.3	492.8	$^{+4.2}_{-4.2} \pm 0.7$	2.3	511.1	$^{+4.6}_{-4.6} \pm 0.6$	2.3
13.0	126.00	515.4	$^{+3.1}_{-3.1} \pm 0.7$	2.3	511.2	$^{+4.4}_{-4.4} \pm 0.7$	2.3	488.8	$^{+4.2}_{-4.2} \pm 0.7$	2.3	506.7	$^{+4.6}_{-4.6} \pm 0.6$	2.3
13.6	124.60	596.6	$^{+3.0}_{-3.0} \pm 0.7$	2.2	592.1	$^{+4.3}_{-4.3} \pm 0.6$	2.2	565.6	$^{+4.1}_{-4.1} \pm 0.6$	2.2	587.0	$^{+4.6}_{-4.6} \pm 0.6$	2.2
13.6	125.00	589.9	$^{+2.9}_{-2.9} \pm 0.7$	2.2	585.9	$^{+4.3}_{-4.3} \pm 0.6$	2.2	559.0	$^{+4.0}_{-4.0} \pm 0.6$	2.2	580.9	$^{+4.5}_{-4.5} \pm 0.6$	2.2
13.6	125.09	589.6	$^{+3.0}_{-3.0} \pm 0.7$	2.2	585.3	$^{+4.3}_{-4.3} \pm 0.6$	2.2	559.0	$^{+4.1}_{-4.1} \pm 0.6$	2.2	580.3	$^{+4.6}_{-4.6} \pm 0.6$	2.2
13.6	125.38	586.2	$^{+3.0}_{-3.0} \pm 0.7$	2.2	581.6	$^{+4.3}_{-4.3} \pm 0.6$	2.2	555.4	$^{+4.1}_{-4.1} \pm 0.6$	2.2	576.6	$^{+4.6}_{-4.6} \pm 0.6$	2.2
13.6	125.60	583.5	$^{+3.0}_{-3.0} \pm 0.7$	2.2	579.1	$^{+4.3}_{-4.3} \pm 0.7$	2.2	553.2	$^{+4.1}_{-4.1} \pm 0.7$	2.2	574.0	$^{+4.6}_{-4.6} \pm 0.6$	2.2
13.6	126.00	577.9	$^{+3.1}_{-3.1} \pm 0.7$	2.2	573.2	$^{+4.3}_{-4.3} \pm 0.6$	2.2	547.2	$^{+4.1}_{-4.1} \pm 0.7$	2.2	568.1	$^{+4.6}_{-4.6} \pm 0.6$	2.2
14.0	124.60	639.7	$^{+2.9}_{-2.9} \pm 0.7$	2.2	634.9	$^{+4.2}_{-4.2} \pm 0.6$	2.2	606.2	$^{+4.0}_{-4.0} \pm 0.6$	2.2	629.6	$^{+4.5}_{-4.5} \pm 0.6$	2.2
14.0	125.00	636.1	$^{+3.0}_{-3.0} \pm 0.6$	2.2	631.1	$^{+4.3}_{-4.3} \pm 0.6$	2.2	602.3	$^{+4.1}_{-4.1} \pm 0.6$	2.2	625.7	$^{+4.5}_{-4.5} \pm 0.6$	2.2
14.0	125.09	633.3	$^{+2.9}_{-2.9} \pm 0.6$	2.2	628.5	$^{+4.2}_{-4.2} \pm 0.6$	2.2	600.1	$^{+4.0}_{-4.0} \pm 0.6$	2.2	623.1	$^{+4.5}_{-4.5} \pm 0.6$	2.2
14.0	125.38	632.4	$^{+3.1}_{-3.1} \pm 0.6$	2.2	627.0	$^{+4.3}_{-4.3} \pm 0.6$	2.2	598.6	$^{+4.1}_{-4.1} \pm 0.6$	2.2	621.5	$^{+4.6}_{-4.6} \pm 0.6$	2.2
14.0	125.60	627.9	$^{+3.0}_{-3.0} \pm 0.6$	2.2	622.5	$^{+4.3}_{-4.3} \pm 0.6$	2.2	594.2	$^{+4.1}_{-4.1} \pm 0.6$	2.2	617.1	$^{+4.5}_{-4.5} \pm 0.6$	2.2
14.0	126.00	621.2	$^{+3.0}_{-3.0} \pm 0.7$	2.2	616.5	$^{+4.2}_{-4.2} \pm 0.6$	2.2	588.6	$^{+4.1}_{-4.1} \pm 0.6$	2.2	611.1	$^{+4.5}_{-4.5} \pm 0.6$	2.2

Table 1: Predictions for the process $t\bar{t}H$ from group III, with different functional form for the central scale.

$\sqrt{s}$ [TeV]	m_H [GeV]	σ [fb]			δ_μ $(+\delta_{\mathrm{ThU}})$			δ_{PDF}			δ_{α_s}		
		I	II	III	I	II	III	I	II	III	I	II	III
13.0	124.60	504.7	509.5	503.8	$^{+7.8}_{-5.9}$	$^{+5.4}_{-6.1}$	$^{+4.1}_{-4.1} \pm 0.7$	2.3	2.2	2.3	0.0	1.5	1.6
13.0	125.00	499.9	505.1	500.5	$^{+7.8}_{-5.9}$	$^{+5.4}_{-6.1}$	$^{+4.2}_{-4.2} \pm 0.7$	2.3	2.2	2.3	0.0	1.5	1.6
13.0	125.09	499.0	503.1	499.0	$^{+7.9}_{-5.9}$	$^{+5.4}_{-6.0}$	$^{+4.2}_{-4.2} \pm 0.7$	2.3	2.2	2.3	0.0	1.5	1.6
13.0	125.38	495.5	500.6	495.1	$^{+7.9}_{-5.9}$	$^{+5.4}_{-6.1}$	$^{+4.1}_{-4.1} \pm 0.7$	2.3	2.2	2.3	0.0	1.5	1.6
13.0	125.60	493.4	497.9	492.8	$^{+7.8}_{-5.9}$	$^{+5.4}_{-6.1}$	$^{+4.2}_{-4.2} \pm 0.7$	2.3	2.2	2.3	0.0	1.5	1.6
13.0	126.00	488.7	493.7	488.8	$^{+7.8}_{-5.9}$	$^{+5.3}_{-6.1}$	$^{+4.2}_{-4.2} \pm 0.7$	2.3	2.2	2.3	0.0	1.5	1.6
13.6	124.60	565.4	570.9	565.6	$^{+7.8}_{-5.9}$	$^{+5.5}_{-6.1}$	$^{+4.1}_{-4.1} \pm 0.6$	2.2	2.1	2.2	0.0	1.5	1.6
13.6	125.00	560.4	566.6	559.0	$^{+7.9}_{-5.9}$	$^{+5.4}_{-6.1}$	$^{+4.0}_{-4.0} \pm 0.6$	2.2	2.1	2.2	0.0	1.5	1.6
13.6	125.09	559.4	564.3	559.0	$^{+7.9}_{-5.9}$	$^{+5.5}_{-6.1}$	$^{+4.1}_{-4.1} \pm 0.6$	2.2	2.1	2.2	0.0	1.5	1.6
13.6	125.38	556.0	561.5	555.4	$^{+7.9}_{-5.9}$	$^{+5.4}_{-6.1}$	$^{+4.1}_{-4.1} \pm 0.6$	2.2	2.1	2.2	0.0	1.5	1.6
13.6	125.60	552.8	558.7	553.2	$^{+8.1}_{-5.9}$	$^{+5.4}_{-6.1}$	$^{+4.1}_{-4.1} \pm 0.7$	2.2	2.1	2.2	0.0	1.5	1.6
13.6	126.00	548.2	553.2	547.2	$^{+7.9}_{-6.0}$	$^{+5.4}_{-6.1}$	$^{+4.1}_{-4.1} \pm 0.7$	2.2	2.1	2.2	0.0	1.5	1.6
14.0	124.60	608.6	614.7	606.2	$^{+8.0}_{-5.9}$	$^{+5.5}_{-6.2}$	$^{+4.0}_{-4.0} \pm 0.6$	2.2	2.1	2.2	0.0	1.5	1.6
14.0	125.00	603.2	609.2	602.3	$^{+8.0}_{-5.9}$	$^{+5.4}_{-6.1}$	$^{+4.1}_{-4.1} \pm 0.6$	2.2	2.1	2.2	0.0	1.5	1.6
14.0	125.09	601.7	607.7	600.1	$^{+7.9}_{-6.0}$	$^{+5.5}_{-6.2}$	$^{+4.0}_{-4.0} \pm 0.6$	2.2	2.1	2.2	0.0	1.5	1.6
14.0	125.38	598.4	603.0	598.6	$^{+7.9}_{-6.0}$	$^{+5.5}_{-6.1}$	$^{+4.1}_{-4.1} \pm 0.6$	2.2	2.1	2.2	0.0	1.5	1.6
14.0	125.60	595.6	600.0	594.2	$^{+7.9}_{-6.0}$	$^{+5.5}_{-6.1}$	$^{+4.1}_{-4.1} \pm 0.6$	2.2	2.1	2.2	0.0	1.5	1.6
14.0	126.00	589.5	595.2	588.6	$^{+7.9}_{-6.0}$	$^{+5.4}_{-6.1}$	$^{+4.1}_{-4.1} \pm 0.6$	2.2	2.1	2.2	0.0	1.5	1.6

Table 2: Predictions for the process $t\bar{t}H$.

2 tH

As far as tH is concerned, three main production mechanisms concur: t-channel, s-channel and tWH associated production. State-of-the-art predictions for these processes include corrections up to NLO QCD [? ?] as well as NLO EW [?]. When the latter are considered, however, interferences between the three production channels cannot be neglected. Thus, the impact of EW corrections can be only assessed by considering all the channels together (possibly imposing the selection cuts which enhance a given channel). In this case, the effect on the inclusive cross section has been found in Ref. [?] to be about -3.5%. Given the rather low rate of these processes, EW corrections are not included in the reference cross sections.

All single-top and Higgs cross-sections presented below are computed with MadGraph5_aMC@NLO [? ?].

2.1 t-channel

We show predictions for t-channel single-top and Higgs associated production in Tabs. 3, 4 and 5, respectively for the processes $tH + \bar{t}H$, tH and $\bar{t}H$, at NLO QCD accuracy, following Ref. [?]. The central value of the cross section is computed in the five-flavour scheme. The central value of the renormalisation and factorisation scales is set to

$$\mu^0_{R,F} = \frac{m_H + m_t}{4}\,. \tag{2.1}$$

The flavour-scheme and scale-variation uncertainty is computed by considering the envelope of the nine-point scale variations (obtained varying $\mu^0_{R,F}$ by a factor 2 up and down) in the four- and five-flavour schemes.

2.2 s-channel

We show predictions for s-channel single-top and Higgs associated production in Tabs. 6, 7 and 8, respectively for the processes $tH + \bar{t}H$, tH and $\bar{t}H$, at NLO QCD accuracy, following Ref. [?]. The central value of the cross section is computed in the five-flavour scheme. The central value of the renormalisation and factorisation scales is set to

$$\mu^0_{R,F} = \frac{m_H + m_t}{2}\,. \tag{2.2}$$

The scale-variation uncertainty is computed by considering the envelope of the nine-point scale variations (obtained varying $\mu^0_{R,F}$ by a factor 2 up and down).

2.3 tWH

We show predictions tWH associated production in Tabs. 9, where the cross section for the process tHW^- and $\bar{t}HW^+$ are summed. Each process, taken alone, contributes to half the cross section. Numbers have been computed at NLO QCD accuracy following Ref. [?]. In particular, the "diagram removal with interference" (DR2) approach, as implemented in the MadSTR plugin [?], is employed to subtract contributions from resonant top quarks

$\sqrt{s}$ [TeV]	m_H [GeV]	σ [fb]	δ_μ	δ_{PDF}	δ_{α_s}
13.0	124.60	76.17	$^{+6.5}_{-15.0}$	1.8	1.2
13.0	125.00	76.04	$^{+6.4}_{-15.9}$	1.8	1.2
13.0	125.09	75.99	$^{+6.4}_{-16.1}$	1.8	1.2
13.0	125.38	75.79	$^{+6.4}_{-15.1}$	1.8	1.2
13.0	125.60	75.67	$^{+6.4}_{-15.8}$	1.8	1.2
13.0	126.00	75.53	$^{+6.4}_{-15.5}$	1.8	1.2
13.6	124.60	85.79	$^{+6.4}_{-16.4}$	1.7	1.2
13.6	125.00	85.38	$^{+6.4}_{-15.5}$	1.7	1.2
13.6	125.09	85.34	$^{+6.3}_{-15.5}$	1.7	1.2
13.6	125.38	85.10	$^{+6.3}_{-15.6}$	1.7	1.2
13.6	125.60	85.00	$^{+6.3}_{-16.0}$	1.7	1.2
13.6	126.00	84.86	$^{+6.3}_{-15.8}$	1.7	1.2
14.0	124.60	92.22	$^{+6.3}_{-15.8}$	1.7	1.2
14.0	125.00	92.02	$^{+6.3}_{-15.0}$	1.7	1.2
14.0	125.09	91.89	$^{+6.3}_{-14.9}$	1.7	1.2
14.0	125.38	91.72	$^{+6.3}_{-16.2}$	1.7	1.2
14.0	125.60	91.75	$^{+6.3}_{-16.0}$	1.7	1.2
14.0	126.00	91.32	$^{+6.3}_{-15.4}$	1.7	1.2

Table 3: Predictions for the process $tH + \bar{t}H$, t-channel.

which appear at NLO. The central value of the renormalisation and factorisation scales is set to

$$\mu^0_{R,F} = \frac{m_H + m_t + m_W}{2} \,. \tag{2.3}$$

The scale-variation uncertainty is computed by considering the envelope of the nine-point scale variations (obtained varying $\mu^0_{R,F}$ by a factor 2 up and down).

$\sqrt{s}$ [TeV]	m_H [GeV]	σ [fb]	δ_μ	δ_{PDF}	δ_{α_s}
13.0	124.60	50.03	$^{+6.5}_{-14.7}$	1.5	1.2
13.0	125.00	49.91	$^{+6.5}_{-15.2}$	1.5	1.2
13.0	125.09	49.89	$^{+6.5}_{-15.3}$	1.5	1.2
13.0	125.38	49.74	$^{+6.4}_{-14.5}$	1.5	1.2
13.0	125.60	49.66	$^{+6.4}_{-15.6}$	1.5	1.2
13.0	126.00	49.62	$^{+6.4}_{-15.1}$	1.5	1.2
13.6	124.60	56.14	$^{+6.4}_{-15.8}$	1.5	1.2
13.6	125.00	56.00	$^{+6.4}_{-15.2}$	1.5	1.2
13.6	125.09	55.83	$^{+6.4}_{-15.0}$	1.5	1.2
13.6	125.38	55.69	$^{+6.3}_{-15.1}$	1.5	1.2
13.6	125.60	55.65	$^{+6.3}_{-15.5}$	1.5	1.2
13.6	126.00	55.60	$^{+6.3}_{-15.4}$	1.5	1.2
14.0	124.60	60.24	$^{+6.3}_{-15.4}$	1.4	1.1
14.0	125.00	60.14	$^{+6.3}_{-14.6}$	1.4	1.1
14.0	125.09	60.03	$^{+6.3}_{-15.2}$	1.4	1.1
14.0	125.38	59.93	$^{+6.3}_{-15.9}$	1.4	1.1
14.0	125.60	60.01	$^{+6.3}_{-15.8}$	1.4	1.2
14.0	126.00	59.63	$^{+6.3}_{-14.8}$	1.4	1.1

Table 4: Predictions for the process tH, t-channel.

$\sqrt{s}$ [TeV]	m_H [GeV]	σ [fb]	δ_μ	δ_{PDF}	δ_{α_s}
13.0	124.60	26.14	$^{+6.4}_{-15.7}$	3.1	1.3
13.0	125.00	26.13	$^{+6.4}_{-17.1}$	3.1	1.3
13.0	125.09	26.10	$^{+6.4}_{-17.6}$	3.1	1.3
13.0	125.38	26.05	$^{+6.4}_{-16.3}$	3.1	1.3
13.0	125.60	26.01	$^{+6.3}_{-16.1}$	3.1	1.3
13.0	126.00	25.91	$^{+6.4}_{-16.4}$	3.1	1.3
13.6	124.60	29.65	$^{+6.3}_{-17.5}$	3.0	1.2
13.6	125.00	29.38	$^{+6.3}_{-16.3}$	3.0	1.2
13.6	125.09	29.50	$^{+6.3}_{-16.5}$	3.0	1.2
13.6	125.38	29.41	$^{+6.3}_{-16.6}$	3.0	1.2
13.6	125.60	29.35	$^{+6.3}_{-16.9}$	3.0	1.2
13.6	126.00	29.27	$^{+6.3}_{-16.5}$	3.0	1.2
14.0	124.60	31.99	$^{+6.3}_{-16.7}$	2.9	1.2
14.0	125.00	31.88	$^{+6.3}_{-15.8}$	2.9	1.2
14.0	125.09	31.86	$^{+6.3}_{-14.4}$	2.9	1.2
14.0	125.38	31.79	$^{+6.2}_{-16.7}$	2.9	1.2
14.0	125.60	31.74	$^{+6.3}_{-16.4}$	2.9	1.2
14.0	126.00	31.69	$^{+6.2}_{-16.6}$	3.0	1.2

Table 5: Predictions for the process $\bar{t}H$, t-channel.

$\sqrt{s}$ [TeV]	m_H [GeV]	σ [fb]	δ_μ	δ_{PDF}	δ_{α_s}
13.0	124.60	2.95	$^{+2.4}_{-1.9}$	2.4	0.2
13.0	125.00	2.93	$^{+2.4}_{-1.9}$	2.4	0.2
13.0	125.09	2.92	$^{+2.4}_{-1.8}$	2.4	0.2
13.0	125.38	2.90	$^{+2.4}_{-1.9}$	2.4	0.2
13.0	125.60	2.89	$^{+2.4}_{-1.8}$	2.4	0.2
13.0	126.00	2.87	$^{+2.5}_{-1.9}$	2.4	0.2
13.6	124.60	3.18	$^{+2.4}_{-1.8}$	2.3	0.2
13.6	125.00	3.15	$^{+2.4}_{-1.8}$	2.3	0.2
13.6	125.09	3.14	$^{+2.4}_{-1.8}$	2.3	0.2
13.6	125.38	3.13	$^{+2.4}_{-1.8}$	2.3	0.2
13.6	125.60	3.12	$^{+2.4}_{-1.8}$	2.3	0.2
13.6	126.00	3.10	$^{+2.4}_{-1.8}$	2.3	0.2
14.0	124.60	3.33	$^{+2.4}_{-1.8}$	2.3	0.3
14.0	125.00	3.30	$^{+2.4}_{-1.8}$	2.3	0.3
14.0	125.09	3.30	$^{+2.4}_{-1.8}$	2.3	0.3
14.0	125.38	3.29	$^{+2.4}_{-1.8}$	2.3	0.3
14.0	125.60	3.27	$^{+2.4}_{-1.8}$	2.3	0.3
14.0	126.00	3.24	$^{+2.4}_{-1.8}$	2.3	0.3

Table 6: Predictions for the process $tH + \bar{t}H$, s-channel.

$\sqrt{s}$ [TeV]	m_H [GeV]	σ [fb]	δ_μ	$\delta_{\rm PDF}$	δ_{α_s}
13.0	124.60	1.93	$^{+2.4}_{-1.8}$	2.5	0.2
13.0	125.00	1.92	$^{+2.4}_{-1.8}$	2.5	0.2
13.0	125.09	1.91	$^{+2.4}_{-1.8}$	2.5	0.2
13.0	125.38	1.90	$^{+2.4}_{-1.8}$	2.5	0.2
13.0	125.60	1.90	$^{+2.4}_{-1.8}$	2.5	0.2
13.0	126.00	1.88	$^{+2.4}_{-1.8}$	2.5	0.2
13.6	124.60	2.07	$^{+2.4}_{-1.8}$	2.4	0.3
13.6	125.00	2.06	$^{+2.4}_{-1.8}$	2.5	0.3
13.6	125.09	2.05	$^{+2.4}_{-1.8}$	2.5	0.3
13.6	125.38	2.05	$^{+2.4}_{-1.8}$	2.5	0.3
13.6	125.60	2.04	$^{+2.4}_{-1.8}$	2.5	0.3
13.6	126.00	2.03	$^{+2.4}_{-1.8}$	2.5	0.3
14.0	124.60	2.17	$^{+2.3}_{-1.7}$	2.4	0.3
14.0	125.00	2.15	$^{+2.3}_{-1.8}$	2.4	0.3
14.0	125.09	2.15	$^{+2.4}_{-1.8}$	2.4	0.3
14.0	125.38	2.14	$^{+2.4}_{-1.8}$	2.4	0.3
14.0	125.60	2.13	$^{+2.3}_{-1.8}$	2.4	0.3
14.0	126.00	2.11	$^{+2.3}_{-1.7}$	2.4	0.3

Table 7: Predictions for the process tH, s-channel.

$\sqrt{s}$ [TeV]	m_H [GeV]	σ [fb]	δ_μ	δ_{PDF}	δ_{α_s}
13.0	124.60	1.02	$^{+2.5}_{-1.9}$	2.6	0.2
13.0	125.00	1.01	$^{+2.5}_{-1.9}$	2.6	0.2
13.0	125.09	1.00	$^{+2.5}_{-1.8}$	2.6	0.2
13.0	125.38	1.00	$^{+2.5}_{-1.9}$	2.6	0.2
13.0	125.60	1.00	$^{+2.4}_{-1.8}$	2.6	0.2
13.0	126.00	0.99	$^{+2.5}_{-1.9}$	2.6	0.2
13.6	124.60	1.10	$^{+2.4}_{-1.8}$	2.5	0.2
13.6	125.00	1.09	$^{+2.4}_{-1.8}$	2.5	0.2
13.6	125.09	1.09	$^{+2.4}_{-1.8}$	2.5	0.2
13.6	125.38	1.09	$^{+2.4}_{-1.8}$	2.5	0.2
13.6	125.60	1.08	$^{+2.4}_{-1.8}$	2.5	0.2
13.6	126.00	1.07	$^{+2.4}_{-1.8}$	2.5	0.2
14.0	124.60	1.16	$^{+2.5}_{-1.8}$	2.5	0.3
14.0	125.00	1.15	$^{+2.4}_{-1.8}$	2.5	0.2
14.0	125.09	1.15	$^{+2.4}_{-1.8}$	2.5	0.3
14.0	125.38	1.14	$^{+2.4}_{-1.8}$	2.5	0.3
14.0	125.60	1.14	$^{+2.4}_{-1.8}$	2.5	0.2
14.0	126.00	1.13	$^{+2.5}_{-1.8}$	2.5	0.2

Table 8: Predictions for the process $\bar{t}H$, s-channel.

$\sqrt{s}$ [TeV]	m_H [GeV]	σ [fb]	δ_μ	δ_{PDF}	δ_{α_s}
13.0	124.60	15.52	$^{+4.6}_{-6.2}$	3.1	2.3
13.0	125.00	15.47	$^{+4.6}_{-6.1}$	3.1	2.3
13.0	125.09	15.41	$^{+4.6}_{-6.2}$	3.1	2.2
13.0	125.38	15.29	$^{+4.7}_{-6.3}$	3.1	2.3
13.0	125.60	15.13	$^{+4.8}_{-6.6}$	3.1	2.3
13.0	126.00	15.06	$^{+4.7}_{-6.4}$	3.1	2.3
13.6	124.60	17.54	$^{+4.6}_{-6.3}$	3.0	2.2
13.6	125.00	17.40	$^{+4.7}_{-6.4}$	3.0	2.2
13.6	125.09	17.37	$^{+4.7}_{-6.4}$	3.0	2.2
13.6	125.38	17.33	$^{+4.7}_{-6.3}$	3.0	2.2
13.6	125.60	17.24	$^{+4.8}_{-6.4}$	3.0	2.2
13.6	126.00	17.07	$^{+4.7}_{-6.3}$	3.0	2.2
14.0	124.60	18.98	$^{+4.8}_{-6.5}$	2.9	2.2
14.0	125.00	18.86	$^{+4.7}_{-6.3}$	2.9	2.2
14.0	125.09	18.76	$^{+4.7}_{-6.4}$	2.9	2.2
14.0	125.38	18.63	$^{+4.8}_{-6.6}$	2.9	2.2
14.0	125.60	18.61	$^{+4.7}_{-6.4}$	2.9	2.2
14.0	126.00	18.45	$^{+4.8}_{-6.5}$	2.9	2.2

Table 9: Predictions for the process $tHW^- + \bar{t}HW^+$ (with DR2). The rate of each of the two processes taken alone is half of the rate of their sum.