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Erratum: Higgs boson pair production in non-linear Effective Field Theory with full m_t-dependence at NLO QCD

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After comparison with the authors of ref. [1], it turned out that the two-loop amplitude used in ref. [2] was missing a term related to triangle-type diagrams, affecting the cases where the ratio between trilinear Higgs coupling c_{hhh} and Yukawa coupling modifier c_t is different from 1 (i.e. the Standard Model (SM) value), or when the effective coupling of a $t\bar{t}$ pair to a Higgs pair, c_{tt}, is nonzero. The SM results are unchanged. Therefore, benchmark points with a value of c_{hhh}/c_t or c_{tt} very different from the SM are the most affected. We have recalculated the values for the cross sections at the 12 benchmark points shown in table 4 of the original paper [2]. In table 1, we show a comparison of the corrected values for the cross sections to the previous values.

In figure 1 we show the effects of the correction on the m_{hh} distribution for benchmark points 1 and 10, which are affected most due to their large value of c_{hhh}. The differences are found to be below $\sim 20\%$ and therefore within the scale and top mass scheme uncertainties. In general, we have observed that the relative size of the scale uncertainty bands is not significantly affected by the correction.

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Benchmark	$\sigma^{\rm old}_{\rm NLO}$ [fb]	$\sigma^{\rm new}_{\rm NLO}$ [fb]			$\sigma^{\rm new}_{\rm NLO}/\sigma_{\rm NLO,SM}$
	14 TeV	13 TeV	13.6 TeV	14 TeV	14 TeV
B_1	194.89	150.80	168.35	180.53	5.48
B_2	14.55	10.06	11.51	12.54	0.38
B_3	1047.37	803.78	894.69	957.79	29.07
B_4	8922.75	7050.62	7811.76	8338.07	253.05
B_5	59.325	48.66	54.93	59.33	1.80
B_6	24.69	20.73	22.97	24.53	0.74
B_7	169.41	140.97	154.92	164.52	4.99
B_{8a}	41.70	30.36	33.87	36.32	1.10
B_9	146.00	101.63	114.01	122.66	3.72
B_{10}	575.86	481.17	529.65	563.00	17.09
B_{11}	174.70	145.84	161.91	173.06	5.25
B_{12}	3618.53	2925.69	3223.98	3429.40	104.08

Table 1. Comparison of the total cross section values at NLO before and after the correction at a centre-of-mass energy of $\sqrt{s} = 14$ TeV and ratio of the new values to the SM cross section, $\sigma_{\rm NLO,SM}(14\,{\rm TeV}) = 32.95$ fb. In addition, we provide corrected cross-section values at $\sqrt{s} = 13$ TeV and 13.6 TeV.

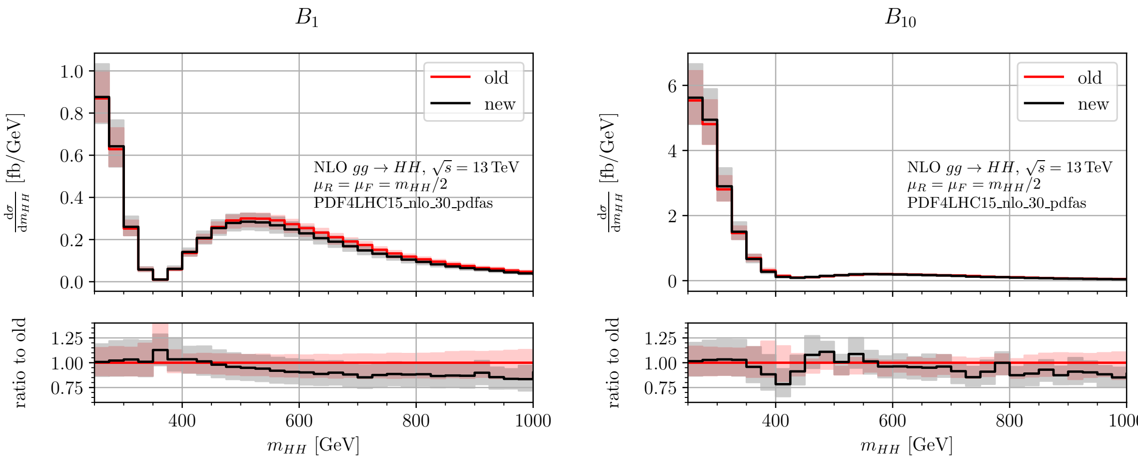

Figure 1. Comparison of old and new results for the cross sections differential in m_{hh} for benchmark points 1 and 10 of table 3 in ref. [2], at $\sqrt{s} = 13$ TeV.

We also provide a new fit of the A_i coefficients at NLO,

$$\begin{aligned}\frac{\sigma_{\rm NLO}}{\sigma_{\rm NLO,SM}} = & A_1 c_t^4 + A_2 c_{tt}^2 + A_3 c_t^2 c_{hhh}^2 + A_4 c_{ggh}^2 c_{hhh}^2 + A_5 c_{gghh}^2 + A_6 c_{tt} c_t^2 + A_7 c_t^3 c_{hhh} \\ & + A_8 c_{tt} c_t c_{hhh} + A_9 c_{tt} c_{ggh} c_{hhh} + A_{10} c_{tt} c_{gghh} + A_{11} c_t^2 c_{ggh} c_{hhh} + A_{12} c_t^2 c_{gghh} \\ & + A_{13} c_t c_{hhh}^2 c_{ggh} + A_{14} c_t c_{hhh} c_{gghh} + A_{15} c_{ggh} c_{hhh} c_{gghh} \\ & + A_{16} c_t^3 c_{ggh} + A_{17} c_t c_{tt} c_{ggh} + A_{18} c_t c_{ggh}^2 c_{hhh} + A_{19} c_t c_{ggh} c_{gghh} \\ & + A_{20} c_t^2 c_{ggh}^2 + A_{21} c_{tt} c_{ggh}^2 + A_{22} c_{ggh}^3 c_{hhh} + A_{23} c_{ggh}^2 c_{gghh}\,, \end{aligned} \tag{1}$$

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Coefficient	13 TeV	13.6 TeV
A_1	2.20913 ± 0.00034	2.20259 ± 0.00014
A_2	11.2754 ± 0.0041	11.31544 ± 0.00062
A_3	0.334152 ± 0.000073	0.331430 ± 0.000029
A_4	0.3520 ± 0.0011	0.34943 ± 0.00030
A_5	12.631 ± 0.036	12.83225 ± 0.00066
A_6	-9.1965 ± 0.0046	-9.18628 ± 0.00060
A_7	-1.54327 ± 0.00035	-1.53405 ± 0.00014
A_8	3.26347 ± 0.00076	3.25036 ± 0.00023
A_9	2.811 ± 0.011	2.7974 ± 0.0014
A_{10}	16.139 ± 0.025	16.12925 ± 0.00096
A_{11}	-1.2628 ± 0.0077	-1.2534 ± 0.0011
A_{12}	-5.818 ± 0.016	-5.7712 ± 0.0012
A_{13}	0.6485 ± 0.0015	0.64328 ± 0.00021
A_{14}	2.8127 ± 0.0025	2.79661 ± 0.00042
A_{15}	3.1813 ± 0.0098	3.16880 ± 0.00089
A_{16}	-0.0075 ± 0.0052	-0.00877 ± 0.00084
A_{17}	0.023 ± 0.012	0.0219 ± 0.0017
A_{18}	0.0171 ± 0.0034	0.01792 ± 0.00037
A_{19}	0.023 ± 0.030	0.0271 ± 0.0014
A_{20}	-0.0279 ± 0.0011	-0.02741 ± 0.00017
A_{21}	0.079 ± 0.027	0.07335 ± 0.00064
A_{22}	0.0150 ± 0.0033	0.01547 ± 0.00043
A_{23}	0.117 ± 0.036	0.11712 ± 0.00082

Table 2. Updated values of the A_i coefficients at NLO, as per eq. (1). The uncertainties quoted here are statistical and include correlations between coefficients.

as given in table 1 of ref. [2]. For the corrected values, our treatment of the uncertainties has also improved, now including statistical uncertainties from the sample of BSM points as well as correlations among the coefficients. We provide them in table 2 for $\sqrt{s} = 13$ and 13.6 TeV, with $\sigma_{\text{NLO,SM}}(13\,\text{TeV}) = 27.80\,\text{fb}$ and $\sigma_{\text{NLO,SM}}(13.6\,\text{TeV}) = 30.82\,\text{fb}$.

We also updated the supplementary material for the A_i coefficients, both for the inclusive cross sections and the cross sections differential in m_{hh}, at $\sqrt{s} = 13$ TeV and $\sqrt{s} = 13.6$ TeV.

We would like to thank the authors of ref. [1] for pointing us to the discrepancy with their result.

Data Availability Statement. This article has no associated data or the data will not be deposited.

Code Availability Statement. This article has no associated code or the code will not be deposited.

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