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# Erratum: SMEFT predictions for $gg \to hh$ at full NLO QCD and truncation uncertainties

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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 show the largest difference, which is up to 35% for benchmark point $1^\star$ in the kinematic range near $m_{hh} = 450\,\text{GeV}$ for truncation option (b), see figure 1. For the other truncation options and for HEFT the qualitative behaviour is similar. For benchmark points $3^\star$ and $6^\star$ the differences are below 10% and therefore within the scale uncertainties, as shown in figure 2.

In table 1 we show the corrected values for the total cross sections for $\Lambda = 1\,\text{TeV}$. The corrected figure for benchmark point $1^\star$ (figure 2 in ref. [2]) is shown below in figure 3. For benchmark points $3^\star$ and $6^\star$ we show the corrected plots for $\Lambda = 1\,\text{TeV}$ in figure 4.

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



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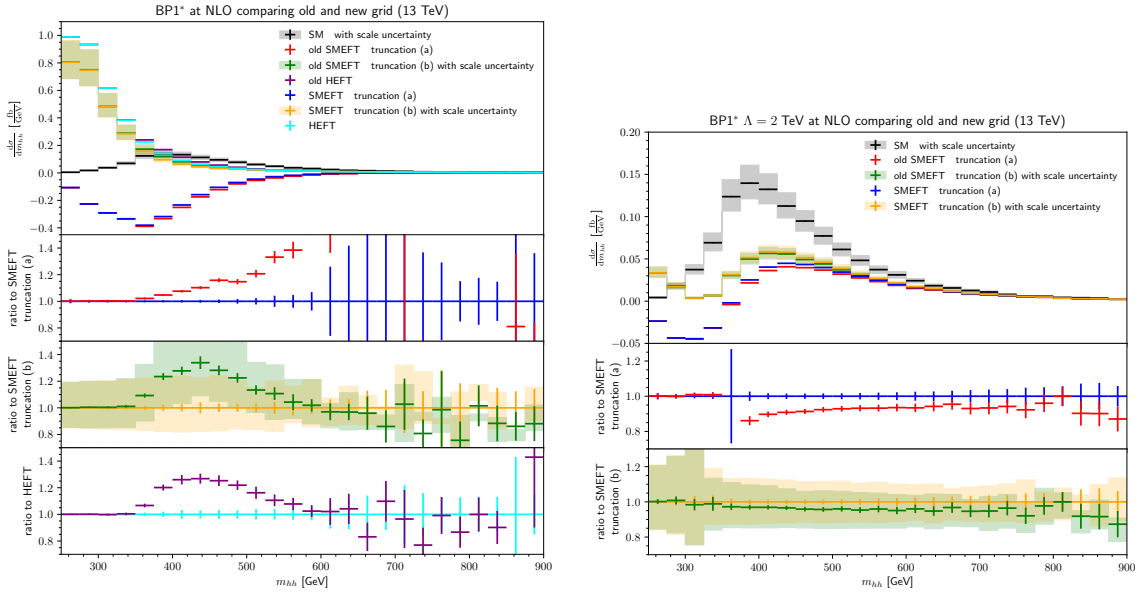


**Figure 1**. Comparison of old and new results for the cross sections differential in $m_{hh}$ for benchmark point $1^\star$ of table 2 in ref. [2], with $\Lambda = 1\,\text{TeV}$ (left) and $\Lambda = 2\,\text{TeV}$ (right), for truncation options (a) and (b). The HEFT distributions for benchmark point $1^\star$ are also included in the left plot. The lower panels show the truncation options separately and normalised to the corrected result (with 3-point scale variations for option (b)).

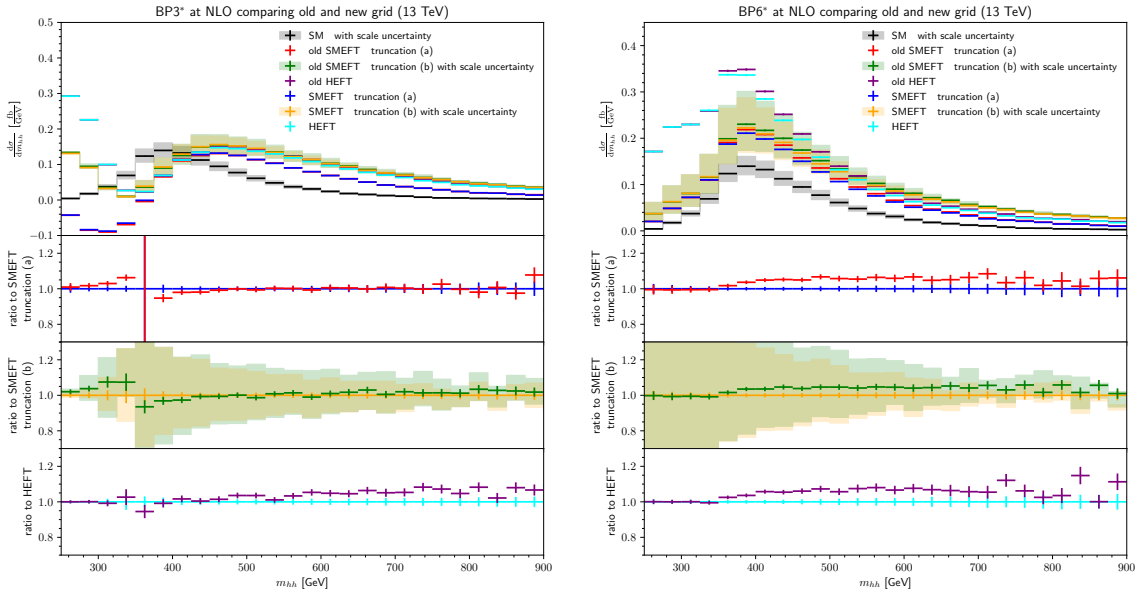


**Figure 2**. Comparison of old and new results for the cross sections differential in $m_{hh}$ for benchmark points $3^\star$ and $6^\star$ of table 2 in ref. [2], with $\Lambda = 1\,\text{TeV}$ and truncation options (a) and (b) and HEFT. The lower panels show the truncation options separately and normalised to the corrected result (with 3-point scale variations for option (b)).

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| benchmark | $\sigma_{\text{NLO}}$[fb] option (b) | K-factor option (b) | ratio to SM option (b) | $\sigma_{\text{NLO}}$[fb] option (a) | $\sigma_{\text{NLO}}$[fb] HEFT |
|---|---|---|---|---|---|
| SM | $27.94^{+13.7\%}_{-12.8\%}$ | 1.67 | 1 | - | - |
| $1^\star$ | $71.95^{+20.1\%}_{-15.7\%}$ | 2.06 | 2.58 | -57.64 | 91.62 |
| $3^\star$ | $68.69^{+9.4\%}_{-9.5\%}$ | 1.80 | 2.46 | 30.15 | 70.20 |
| $6^\star$ | $70.18^{+18.8\%}_{-15.5\%}$ | 1.83 | 2.51 | 50.82 | 87.9 |

**Table 1**. Total cross sections for Higgs-boson pair production at full NLO QCD for three benchmark points and truncation option (b) for $\Lambda = 1\,\text{TeV}$. The total cross sections for truncation option (a) are also given, in order to highlight the difference to the linearised case, as well as the values for HEFT. The uncertainties are scale uncertainties based on 3-point scale variations.

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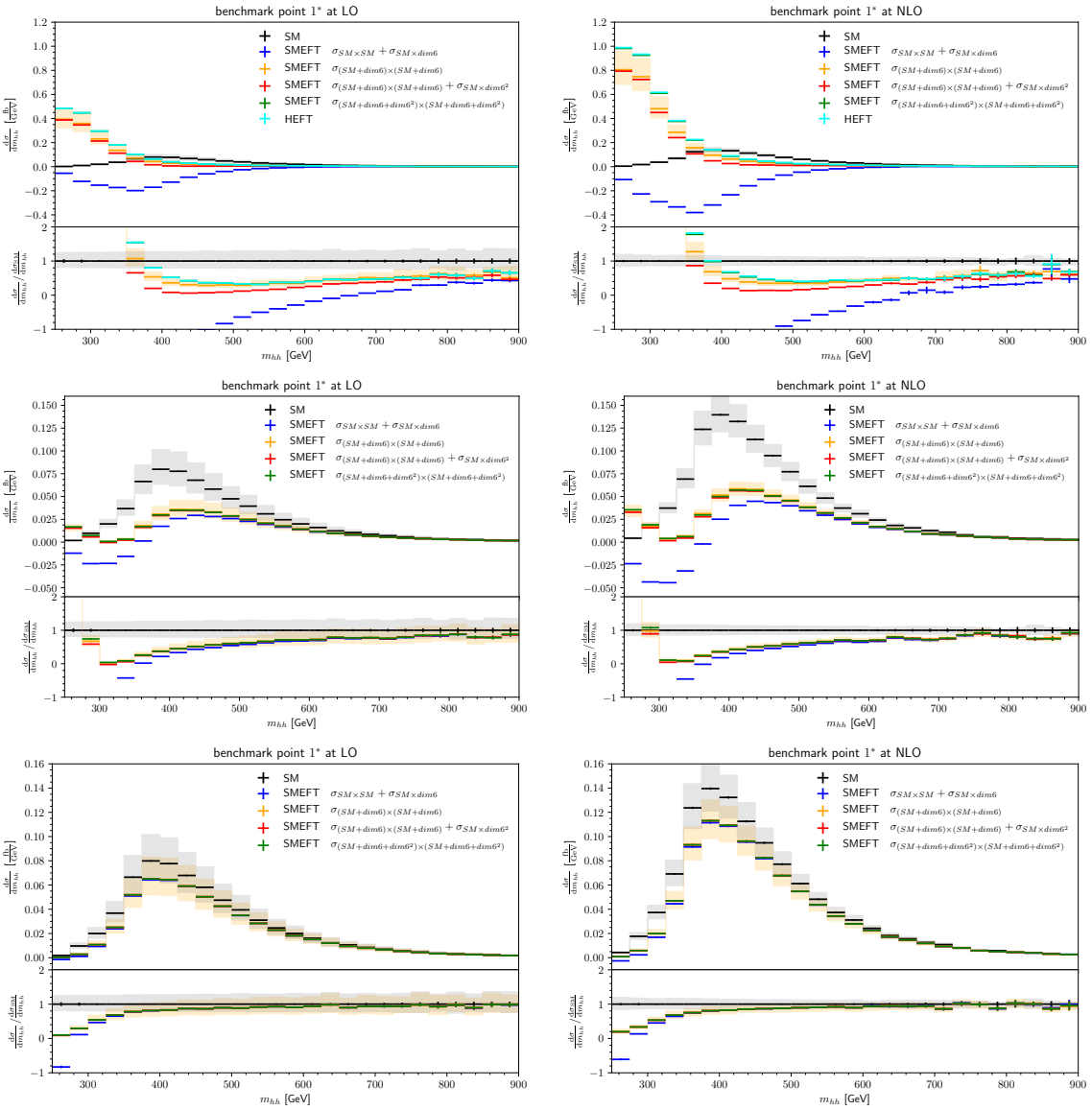


**Figure 3**. Differential cross sections for the invariant mass $m_{hh}$ of the Higgs-boson pair for benchmark point 1⋆ of table 2 in ref. [2]. Top row: $\Lambda = 1\,\text{TeV}$, middle row: $\Lambda = 2\,\text{TeV}$, bottom row: $\Lambda = 4\,\text{TeV}$. Left: LO, right: NLO.

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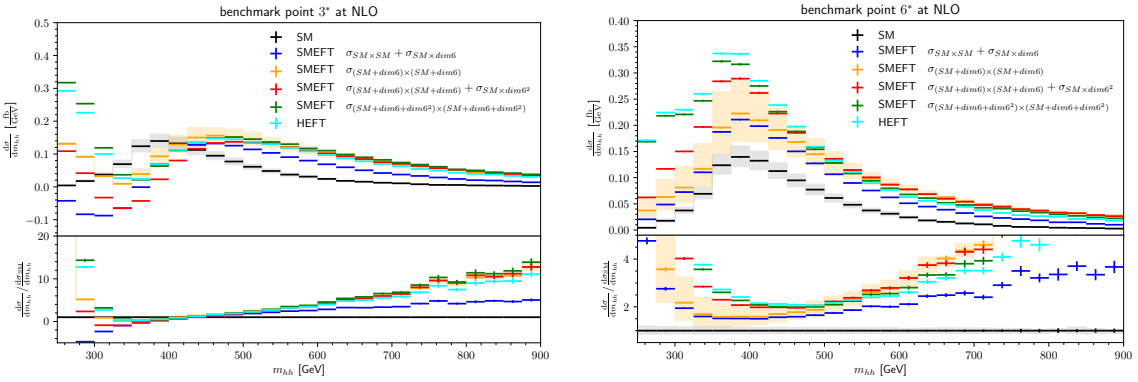


**Figure 4**. Differential cross sections at NLO for the invariant mass $m_{hh}$ of the Higgs-boson pair for benchmark points 3* and 6*, for $\Lambda = 1\,\text{TeV}$.



## References

[1] E. Bagnaschi, G. Degrassi and R. Gröber, *Higgs boson pair production at NLO in the POWHEG approach and the top quark mass uncertainties*, arXiv:2309.10525 [INSPIRE].

[2] G. Heinrich, J. Lang and L. Scyboz, *SMEFT predictions for $gg \to hh$ at full NLO QCD and truncation uncertainties*, *JHEP* **08** (2022) 079 [arXiv:2204.13045] [INSPIRE].

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