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Universal four-dimensional representation of $H \to \gamma\gamma$ at two loops through the Loop-Tree Duality

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We extend useful properties of the $H \to \gamma\gamma$ unintegrated dual amplitudes from one- to two-loop level, using the Loop-Tree Duality formalism. In particular, we show that the universality of the functional form - regardless of the nature of the internal particle - still holds at this order. We also present an algorithmic way to renormalise two-loop amplitudes, by locally cancelling the ultraviolet singularities at integrand level, thus allowing a full four-dimensional numerical implementation of the method. Our results are compared with analytic expressions already available in the literature, finding a perfect numerical agreement. The success of this computation plays a crucial role for the development of a fully local four-dimensional framework to compute physical observables at the Next-to-Next-to Leading order and beyond.

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