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## Precise prediction for the top quark width

*Friday, 7 July 2023 14:00 (25 minutes)*

We present the first full analytic results of next-to-next-to-leading order (NNLO) QCD corrections to the top-quark decay width  $\Gamma(t \rightarrow W b)$  by calculating the imaginary part of three-loop top-quark self-energy diagrams. The results are all expressed in terms of harmonic polylogarithms and are valid in the whole region  $0 \leq m_W \leq m_t$ . The expansions in the  $m_W \rightarrow 0$  and  $m_W \rightarrow m_t$  limits coincide with previous studies. Our results can also be taken as the exact prediction for the lepton invariant mass spectrum in semileptonic  $b \rightarrow u$  decays. We also analytically compute the decay width including the off-shell  $W$  boson effect up to NNLO in QCD for the first time. Combining these contributions with electroweak corrections and the finite  $b$ -quark mass effect, we determine the most precise top-quark width to be 1.331 GeV for  $m_t = 172.69$  GeV. The total theoretical uncertainties including those from renormalization scale choice, top-quark mass renormalization scheme, input parameters and missing higher-order corrections are scrutinized and found to be less than 1%.

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