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Precision Predictions for Higgs and Top-Quark Pair Production at Hadron Colliders

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Precision Predictions for Top-Quark Pair Production at Hadron Colliders
Content
Precision predictions for phenomenologically interesting observables such as the t-tbar invariant mass distribution and forward-backward asymmetry in top-quark pair production at hadron colliders require control over the differential cross section in perturbative QCD. We improve existing calculations of the doubly differential cross section in the invariant mass and scattering angle by using techniques from soft-collinear effective theory to perform an NNLL resummation of threshold logarithms, which become large when the invariant mass M of the top-quark pair approaches the partonic center-of-mass energy sqrt(s hat). We match our results in the threshold region with the exact results at NLO in fixed-order perturbation theory, and perform a numerical analysis of the invariant mass distribution, the total cross section, and the forward-backward asymmetry. Using MSTW2008NNLO parton distribution functions (PDFs), we obtain for the inclusive production cross sections at the Tevatron and LHC the values sigma_{t tbar} = (6.30 +-0.19 -0.23+0.31) pb at the Tevatron and sigma_{t tbar} = (149 +-7 +-8) pb at the LHC, where the first error results from scale variations while the second reflects PDF uncertainties.

Precision Predictions for Higgs Production at Hadron Colliders
Content
We use renormalization-group methods in effective field theory to improve the theoretical prediction for the cross section for Higgs-boson production at hadron colliders. In addition to soft-gluon resummation at Nˆ3LL, we also resum enhanced contributions of the form (C_A x pi x alpha_s)ˆn, which arise in the analytic continuation of the gluon form factor to time-like momentum transfer. This resummation is achieved by evaluating the matching corrections arising at the Higgs-boson mass scale at a time-like renormalization point muˆ2<0, followed by renormalization-group evolution to muˆ2>0. We match our resummed result to NNLO fixed-order perturbation theory and give numerical predictions for the total production cross section as a function of the Higgs-boson mass. Resummation effects are significant even at NNLO, where our improved predictions for the cross sections at the Tevatron and the LHC exceed the fixed-order predictions by about 13% and 8%, respectively, for m_H=120 GeV. We also discuss the application of our technique to other time-like processes such as Drell-Yan production, e+ e- ⟶ hadrons, and hadronic decays of the Higgs boson.

Primary author: NEUBERT, Matthias (Mainz University)

Presenter: NEUBERT, Matthias (Mainz University)

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