

$\Upsilon(nS)$ cross section measurement at 13.6 TeV at CMS

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The production cross section of $\Upsilon(nS)$ ($n=1,2,3$) bottomonium states are measured in proton-proton collisions at $\sqrt{s} = 13.6$ TeV using a data sample corresponding to an integrated luminosity of 37.4 fb^{-1} collected in 2022 by the CMS experiment. The measurement is performed within dimuon transverse momentum range $20 \text{ GeV}/c < p_T < 200 \text{ GeV}/c$ and rapidity range $0.0 \leq |y| \leq 1.4$.

Signal yields are extracted via extended maximum likelihood fits to the dimuon invariant mass spectrum using double Crystal Ball functions. Detector acceptance is determined from particle-gun Monte Carlo simulations, while reconstruction and selection efficiencies are evaluated using a data-driven tag-and-probe method. The differential cross sections are measured as functions of rapidity and transverse momentum. Systematic uncertainties arise from signal and background modeling, acceptance and efficiency calculations, luminosity determination (1.4%), and polarization effects.

Compared to the previous 13 TeV analysis, this measurement extends to lower p_T regions and achieves significantly improved statistical precision. The results are compared to earlier measurements and NLO NRQCD theoretical predictions, showing good agreement in shape while theory slightly overestimates the absolute cross section values.

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