Measurement of dijet production with a leading proton in proton-proton collisions at $\sqrt{s} = 8$ TeV

The CMS and TOTEM Collaborations

Abstract

A study of dijet production associated with a leading proton is presented. The analysis is based on a common data set collected simultaneously with the CMS and TOTEM detectors at the LHC with proton-proton collisions at $\sqrt{s} = 8$ TeV during a dedicated run with $\beta^{*} = 90$ m, at low instantaneous luminosity. The data correspond to an integrated luminosity of 37.5 nb$^{-1}$. The analysis presents the measurement of the dijet production cross section, as a function of $\xi$, the proton fractional momentum loss, and as a function of $t$, the 4-momentum transfer squared at the proton vertex. The dijet cross section in the kinematic region defined by $\xi < 0.1$, $0.03 < |t| < 1$ GeV$^2$, with at least two jets with transverse momentum $p_T > 40$ GeV, and pseudorapidity $|\eta| < 4.4$, is measured as $21.7 \pm 0.9$ (stat) $^{+3.0}_{-3.0}$ (syst) $\pm 0.9$ (lumi) nb. Both the processes $pp \rightarrow pX$ and $pp \rightarrow Xp$, i.e. with the proton scattering to either side of the interaction, are measured, with $X$ including a system of two jets. The results correspond to the average of their cross sections. The ratio of the single-diffractive to inclusive dijet yields, normalised per unit of $\xi$, is presented as a function of $x$, the longitudinal momentum fraction of the proton carried by the struck parton. The ratio in the kinematic region defined above, for $x$ values in the range $-2.9 \leq \log_{10} x \leq -1.6$, was measured as $R = \left( \sigma^{pX}_{jj} / \Delta \xi \right) / \sigma_{jj} = 0.025 \pm 0.001$ (stat) $\pm 0.003$ (syst). The results are compared to the predictions from models of diffractive and non-diffractive interactions.