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Hard color-singlet exchange in dijet events in proton-proton collisions at sqrt(s) = 13 TeV in CMS and TOTEM

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This paper presents an experimental study of proton-proton collision events where the two leading jets are separated by a large pseudorapidity interval devoid of particle activity, referred to as jet-gap-jet events. The pseudorapidity gap is expected from hard color-singlet exchange. The analysis is based on data collected by the CMS and TOTEM experiments during a low luminosity, high- β^* run at the CERN LHC in 2015. Events with a low number of charged particles between the jets are observed in excess of calculations that assume only color-exchange dijet contributions. The fraction of dijet events produced via color-singlet exchange, f_{CSE} , is measured as a function of $p_{\text{T}}^{\text{jet2}}$, the pseudorapidity difference between the two leading jets, and the azimuthal angular separation between the two leading jets. The fraction f_{CSE} has values of 0.6-1.0\%. It increases with the pseudorapidity difference between the jets, has a weak dependence on $p_{\mathrm{T}}^{\mathrm{jet2}}$, and increases as the azimuthal angular difference between the jets approaches π . The results are compared with previous measurements and with predictions from perturbative quantum chromodynamics. In addition, the paper presents the first study of jet-gap-jet events detected in association with an intact proton, interpreted as a proton-gap-jet-gap-jet topology, using a subsample of events with an integrated luminosity of 0.40 pb^{-1} . The intact protons are detected with the Roman pot detectors of the TOTEM experiment. The f_{CSE} measured in this sample is 2.91 ± 0.70 (stat) $^{+1.02}_{-0.94}$ (syst) times larger than that for inclusive dijet production in dijets with similar kinematics.

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