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Searching for optimal conditions for exploration of double-parton scattering in four-jet production at the LHC

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Double-parton scattering (DPS) effects were discussed recently for different reactions. So far no clear and spectacular effect was observed for jet production where single-parton scattering (SPS) contributions dominate. We discuss four-jet production at the LHC. We calculate cross section for both single-parton scattering (SPS) using the ALPGEN code and for double-parton scattering (DPS) in collinear approach [1] as well as in k_t-factorization approach [2]. Our results are compared with experimental data obtained recently by the CMS Collaboration [3]. We show that the ALPGEN code relatively well describes distributions in rapidity of each of the four jets ordered by their transverse momenta. The SPS mechanism does not explain the distributions at large rapidity for the leading, second, third and fourth jet. The DPS mechanism improves the agreement with the experimental data in this corner of the phase space. We try to find better conditions where the relative DPS contribution is enhanced. This would open a possibility to explore the DPS effects experimentally. The total cross sections for the DPS mechanism obtained witin the k_t-factorization approach are slightly smaller than in the case of the collinear approach. Application of the k_t-factorization framework extends our former analysis of different correlation observables that may be useful for further experimental identification of the DPS effects in four-jet sample \cite{MS2016}.
Results obtained in the two approaches are compared and appearing differences are discussed.

[1] R. Maciula and A. Szczurek, Searching for and exploring double-parton scattering effects in four-jet production at the LHC, Phys. Lett. B 749 (2015) 57-62.

[2] R. Maciula et al., a paper in preparation.

[3] S. Chatrchyan et al. [CMS Collaboration], Measurement of four-jet production in proton-proton collisions at $\sqrt{s} = 7$ TeV, Phys. Rev. D 89, 092010 (2014).

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