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Double open charm meson production at the LHC: New single- and double-parton scattering mechanisms

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Collaboration

Abstract content

Some time ago two of us predicted that at large energies relevant for the LHC the production of double charm should be dominated by the double-parton scattering (DPS) mechanism [1]. Those studies of double $\bar{c}c$ production was extended next to the k_t-factorization approach which includes effectively higher-order QCD effects [2, 3]. A relatively good description of the LHCb experimental data [4] was achieved for both the total yield and the dimeson correlation observables. The single-parton scattering (SPS) $gg \to c\bar{c}c\bar{c}$ contribution was discussed carefully in both collinear [3] and k_t-factorization [5] approaches. Their contribution to the $c\bar{c}c\bar{c}$ cross section was found to be rather small and was not able to describe details of the LHCb data.

Here we discuss production of D^0D^0 (and $\bar{D}^0\bar{D}^0$) pairs within an alternative approach where g $\to$ D fragmentation is included [6]. We consider double-parton scattering (DPS) mechanisms of double $c\bar{c}$ production and subsequent $cc \to D^0D^0$ hadronization as well as double g and mixed $gc\bar{c}$ production with $gg \to D^0D^0$ and $gc \to D^0D^0$ hadronization calculated with the help of the scale-dependent hadronization functions of Kniehl et al. Single-parton scattering (SPS) mechanism of digluon production is also taken into account. We compare our results with several correlation observables in azimuthal angle $\phi_{D^0D^0}$ between D^0 mesons or in dimeson invariant mass $M_{D^0D^0}$. The inclusion of new mechanisms with $g \to D^0$ fragmentation leads to larger cross sections, than when including only DPS mechanism with standard scale-independent $cc \to D^0D^0$ fragmentation functions. Some consequences of the presence of the new mechanisms are discussed. In particular a larger σ_{eff} is needed to describe the LHCb data. There is a signature that σ_{eff} may depend on transverse momentum of c quarks and/or $\bar{c}$ antiquarks.

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