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# Examination of final-state effects in pPb collisions via measurements of the multiplicity dependence of charm hadron production with CMS

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The large masses of charm hadrons make them exceptional probes of quantum chromodynamics (QCD), providing quantitative insights into its high-density and temperature phase through their production and interaction in the nuclear medium. Charm hadron production in heavy ion collisions is influenced by several mechanisms, including energy loss, dissociation, and recombination processes. Final-state effects further modify the hadronization of heavy quarks via interactions with nearby particles (co-moving particles, quark coalescence, etc). Studying the modification of hadron production in dense environments enables the investigation of hadronization mechanisms as well as of the origin of the collectivity signals observed in the so-called small systems. We present new measurements of the production rate of charm hadrons as a function of the charged particle multiplicity in proton-lead (pPb) collisions at $\sqrt{s_{\mathrm{NN}}} = 8.16$ TeV. We report the first study of the prompt and nonprompt (from b-hadron decay) $\psi(2\mathrm{S})$-over-$J/\psi$ cross section ratio. The results are compared with previous measurements in proton-proton (inclusive, prompt, and nonprompt) and pPb (inclusive) collisions, as well as with predictions from a comover-interaction model. In addition, measurements of the production of open charm hadrons such as $\Lambda_c^+$ and $D^0$ will be presented.

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