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Strangeness and light flavor production as a function of multiplicity in proton-proton collisions measured with ALICE (8' + 2')

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The production of $\pi^{\pm}$, $K^{\pm}$, K^0_S, p ($\bar{p}$), Λ, Ξ^- ($\bar{\Xi}^+$) and Ω^- ($\bar{\Omega}^+$) hadrons is measured at midrapidity in proton-proton (pp) collisions at $\sqrt{s}$ = 7 TeV as a function of charged-particle multiplicity. In order to avoid autocorrelation biases, events are classified according to the signal measured in the VZERO detector, located at forward rapidity, and observables are studied as a function of average charged-particle multiplicity at midrapidity, $\langle \mathrm{d}N_{\mathrm{ch}}/\mathrm{d}\eta \rangle$. The transverse momentum distributions of all measured particles are observed to become harder for higher multiplicity collisions and the baryon-to-meson ratios p/π and Λ/K^0_S exhibit an evolution similar to what is observed in collisions involving nuclei. In nucleus-nucleus collisions, such features are usually interpreted as consequences of a hydrodynamical evolution of the colliding system.

The production rate of strange particles increases faster with $\langle \mathrm{d}N_{\mathrm{ch}}/\mathrm{d}\eta \rangle$ than those of non-strange hadrons. Therefore, strange particle production is enhanced relative to pions in high multiplicity pp collisions, similarly to what occurs in proton-nucleus and nucleus-nucleus collisions at the LHC. These results represent the first observation of an enhanced production of strange hadrons in high-multiplicity pp collisions. This increase of strangeness production is seen to depend on the number of strange valence quarks and is of more than a factor two for the Ω for the highest multiplicity studied, which is of approximately three times the inclusive value. Particle ratios of species with no strange quark content, such as p/π, exhibit no dependence with multiplicity, indicating that the phenomenon does not relate to mass but rather to strangeness content. None of the common Monte Carlo models used at LHC energies is able to describe these observations, suggesting that particle production mechanisms need to be revisited in these models.

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