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Balance functions of identified hadrons in Pb-Pb, p-Pb and p-p collisions from ALICE

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In ultrarelativistic heavy-ion collisions, correlations of particles with opposite quantum numbers provide insight into charge creation mechanisms, the time scales of quark production, collective motion of the QGP, and re-scattering in the hadronic phase. The longitudinal and azimuthal widths of general charge balance functions for pions, kaons, and protons are used to examine the two-wave quark production model recently proposed to explain quark-antiquark production within the QGP, which predicts a large increase in up and down quark pairs relative to strange quark pairs around the time of hadronization. Furthermore, the magnitudes of the balance functions for different particle pairs provide quantitative differential information on pair production channels. In addition, a detailed study of balance functions for different identified hadrons probes the fragmentation mechanism of strings into different quark flavors. Balance functions are also analysed in small collision systems such as p-Pb and pp to study fragmentation effects and possible collective effects in high-multiplicity events.

We present a comprehensive set of measurements of general charge balance functions for pions, kaons, protons, and unidentified particle pairs in Pb-Pb ($\sqrt{s_{\rm NN}} = 2.76$ and 5.02 TeV), p-Pb ($\sqrt{s_{\rm NN}} = 5.02$ TeV) and pp ($\sqrt{s} = 5.02$ and 7 TeV) collisions in ALICE. Theoretical expectations and Monte Carlo models are then compared with the experimental data. In Pb-Pb collisions, we observe that the Δy and $\Delta\varphi$ widths of the charged-pion balance function are narrower in central collisions compared to peripheral ones, while the widths of the charged-kaon balance functions do not show a centrality dependence. These results are consistent with expectations based on the two-wave scenario and radial flow.

Content type

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