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Exploring the baryon production mechanism using angular correlations with the ALICE experiment

Angular ($\Delta\eta\Delta\varphi$) correlations of identified particles in ultrarelativistic proton-proton and heavy-ion collisions exhibit features dependent on collision systems and particle types. These characteristics stem from mechanisms such as (mini-)jets, elliptic flow, resonance decays, and conservation laws, with quantum statistics and final-state interactions influencing each particle pair's unique correlation function.
ALICE [1] and STAR [2] measurements of $\Delta\eta\Delta\varphi$ correlations show distinctions in baryon versus meson production. While meson correlation functions display an expected near-side peak attributed to mini-jet fragmentation, which is well reproduced by general-purpose Monte Carlo (MC) models, baryon-baryon correlations reveal a surprising near-side anti-correlation structure. This effect has not been reproduced by the MC models until recently [3, 4, 5, 6], posing fundamental questions about the production mechanism of baryons.
This talk presents new insights into this "baryon correlation puzzle". Using Run 2 data from ALICE, a comprehensive study of multiplicity centrality dependent angular correlation functions for pairs of pions, kaons, and protons in pp, p–Pb, and Pb–Pb collisions, along with new Run 3 results for pp collisions at 13.6 TeV, are provided. These include correlation functions for baryon pairs and a new analysis of strange and charm sectors, featuring multi-strange baryons ($p\Xi$, $p\Omega$), $p\phi$, and pD correlations, allowing for tests of mass dependence and baryon number conservation.
References
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Category

Experiment

Collaboration (if applicable)

ALICE

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