

Extraction of the One-Dimensional Particle Source Distribution Relative to the Reaction Plane in Non-Central Pb-Pb Collisions at $\sqrt{s} = 5.36$ TeV with ALICE

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Abstract

In non-central heavy-ion collisions, a strong magnetic field is created for a very short time. Even though it does not last long, it can shape the early dynamics so that matter forms clustered substructures along the axis parallel to the field, giving an uneven (inhomogeneous) density distribution. This inhomogeneity may survive afterward as a long-lived, metastable state, sometimes called primordial inhomogeneity [1]. This work aims at an experimental search for such a spatially modulated source using Pb-Pb collision data collected by ALICE. Hanbury-Brown-Twiss (HBT) interferometry is employed to study identical $\pi^\pm$ pairs. If the source carries a periodic spatial modulation, a secondary peak is expected in the correlation function at a relative momentum reflecting the modulation wavelength, for pairs whose relative momentum is aligned with the magnetic-field direction. A central requirement of this analysis is the event-by-event determination of an axis correlated with the magnetic-field direction. This axis is approximated by the reaction-plane orientation, reconstructed via the second-order (elliptic-flow) event plane v_2 [2], which provides sufficient event-plane resolution at mid-rapidity for this purpose. The correlation is therefore analyzed not in the conventional out-side-long basis but in a basis spanned by the magnetic-field, reaction-plane, and beam directions. This contribution presents the analysis methods that make such studies possible.

References

- [1] K. Fukushima, Y. Hidaka, K. Inoue, K. Shigaki, and Y. Yamaguchi, “Hanbury-Brown–Twiss signature for clustered substructures probing primordial inhomogeneity in hot and dense QCD matter” *Phys. Rev. C* **109**, L051903 (2024).
- [2] ALICE Collaboration, “Azimuthally differential pion femtoscopy in Pb-Pb collisions at $\sqrt{s_{NN}} = 2.76$ TeV” *Phys. Rev. Lett.* **118**, 222301 (2017).