Azimuthal correlation measurements in a heavy-ion collisions*

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Azimuthal anisotropic flow in heavy-ion collisions is recognized as a key observable used to infer information about the early time evolution of the nucleus-nucleus interaction. We report recent results by the ALICE Collaboration at the LHC on the identified particle elliptic flow v_2 measured in Pb-Pb collisions at $\sqrt{s_{\rm NN}} = 2.76$ TeV. ALICE experimental findings from the search for effects of local parity violation in the strong interaction using charge dependent azimuthal correlations with respect to the reaction plane are also discussed.

v_2 of identified particles at high $p_{\rm T}$

Identified particle anisotropic flow is sensitive to the particle production mechanism in different transverse momentum, $p_{\rm T}$, regions. For $p_{\rm T} < 2-3$ GeV/c, the particle type dependence of v_2 is qualitatively described by hydrodynamic model calculations. At intermediate $p_{\rm T}$, $3 < p_{\rm T} < 6$ GeV/c, the observed flow of the baryons is larger than that of the mesons. For $p_{\rm T} > 8$ GeV/c, the high-energy parton fragmentation due to initial hard scatterings is expected to play the dominant role. While traversing the hot and dense quark matter these partons experience collisional and radiative energy losses, which are strongly dependent on the thickness of the created medium. In azimuthally asymmetric system, the energy loss depends on the azimuthal emission angle of the parton, which leads to an azimuthal anisotropy in particle production at high $p_{\rm T}$. Figure 1 presents charged pion and proton $v_2(p_{\rm T})$ in

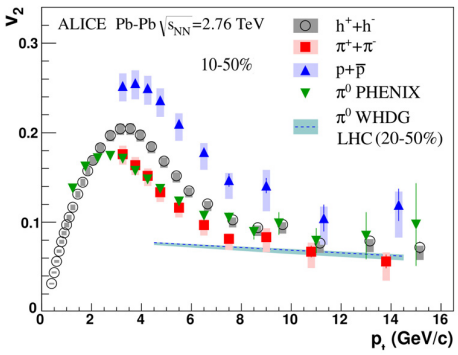

Figure 1: $v_2(p_{\rm T})$ of $\pi^{\pm}$ and $\bar{\rm p}/{\rm p}$ measured by ALICE compared to π^0 v_2 at RHIC and WHDG model calculations.

the 10-50% centrality range of Pb-Pb collisions. The proton v_2 is higher than that of pions up to $p_{\rm T} = 8$ GeV/c which is qualitatively consistent with a picture where particle production in this intermediate $p_{\rm T}$ region includes the interaction of jet fragments with bulk matter. The magnitude of the measured charged pion v_2 for $p_{\rm T} > 8$ GeV/c is compatible with that of unidentified charged particles, and the π^0 v_2 measured by PHENIX in Au-Au collisions at $\sqrt{s_{\rm NN}} = 0.2$ TeV. Results are reproduced by the WHDG model calculations for neutral pions.

Charge dependent correlations

The parity symmetry violation in strong interactions remains one of the open fundamental questions in quantum chromodynamics. It is argued that parity symmetry can be locally violated in a heavy-ion collision which will result in an experimentally observable separation of charges along the extreme magnetic field generated by the moving ions, the so called chiral magnetic effect (CME). As an experimental probe of the CME it was proposed to use the azimuthal correlations with respect to the collision reaction plane which is perpendicular to the magnetic field generated in the collision. ALICE observed a clear charge dependence of the two-particle correlation with respect to the reaction plane as shown in Fig. 2. The observed difference between the same- and opposite charge correlations may in part originate from effects of local parity violation. However, a number of other charge dependent effects which preserve parity symmetry can also contribute. At the moment none of the models is able to reproduce simultaneously the charge dependence and the charge insensitive baseline of the measured correlations.

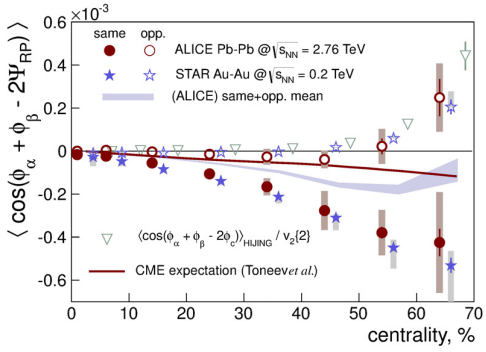

Figure 2: Centrality dependence of the 3-particle correlator measured with respect to the reaction plane.

References

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