Azimuthal anisotropy in 5.02 TeV Pb+Pb and 5.44 TeV Xe+Xe collisions with the ATLAS experiment

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Motivation

 Azimuthal anisotropy results from different pressure gradients S in different spatial directions



Particle azimuthal distribution

Fingles:
$$\frac{dN}{d\phi} \propto 1 + \sum_{n} 2v_n \cos[n(\phi - \Phi_n)]$$

Pairs: $\frac{dN}{d\Delta\phi} \propto 1 + \sum_{n} 2v_n^a v_n^b \cos[n(\Delta\phi)]$



Motivation

Azimuthal anisotropy results from different pressure gradients in different spatial directions



- Pb+Pb 5.02 TeV \rightarrow 0.49nb⁻¹
- Xe+Xe 5.44 TeV \rightarrow 3 μ b ⁻¹

Particle azimuthal distribution



Two-particle correlations (2PC) and scalar-product (SP) methods

0

v_n harmonics in Pb+Pb collisions



- ♦ v_n measured up to p_T = 60 GeV → v₂(p_T) positive at highest p_T → provide information about parton energy loss
- \diamond The ordering: $v_n > v_{n+1}$ in mid-central and peripheral collisions
 - $v_3 > v_4 > v_5 \approx v_2$ for the most central collisions at $p_T = 3-5$ GeV
- \diamond The v₇ harmonic is found to be non-zero for centralities 0-50%

Ref: arXiv:1808.03951

Universal scaling of v_n harmonics

Ref: arXiv:1808.03951



Simultanous scaling along the p_T and v_n axes was performed

 \rightarrow Universal shapes for the v_n (n=2,3) across the different centrality classes

 \rightarrow Similarity in properties of the QGP evolving from different initial conditions

Xe+Xe collisions – initial state fluctuations

Ref: ATLAS-CONF-2018-011



- Integrated v_n higher in the most central events for Xe+Xe
 - Smaller collision system → larger initial fluctuations

Reduced v_n{Xe+Xe} value in mid-central and peripheral

Viscous effects

 Ratio v_n{Xe+Xe}/v_n{Pb+Pb} consistent with theoretical predictions (TRENTO model): Phys.Rev.C97,034904(2018)

Summary

- New results from Pb+Pb and Xe+Xe collisions are obtained (arXiv:1808.03951, ATLAS-CONF-2018-011)
- Thanks to the excellent ATLAS detector and rich datasets:

 \rightarrow Measured flow harmonics up v₇ and to a very high p_T in Pb+Pb

 \rightarrow Performed a comprehensive study of flow in Xe+Xe collisions at 5.44 TeV and compared to Pb+Pb at 5.02 TeV

Thank you for your attention!

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ABSTRACT

The high-statistics experimental data collected by the ATLAS experiment during the 2015 Pb+Pb and 2017 Xe+Xe LHC runs are used to measure charged particle azimuthal anisotropy. The flow harmonics, v_n (n=2-7), are obtained with the two-particle correlation, scalar-product and event-plane methods. Measurements of differential and global Fourier harmonics in Pb+Pb and Xe+Xe collisions in a wide range of transverse momenta (up to 60 GeV), pseudorapidity ($|\eta| < 2.5$) and collision centrality (0-80%) are presented. The higher order harmonics, sensitive to fluctuations in the initial state, are precisely measured. In this analysis the v_i is obtained for the first time. The new flow results allow to improve the understanding of initial conditions of nuclear collisions, hydrodynamical behavior of quark-gluon plasma and parton energy loss.



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