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Measurement of the transverse and longitudinal dynamics of collective flow in 2.76 and 5.02 TeV Pb+Pb collisions with the ATLAS detector

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The collisions of lead nuclei provided by the LHC in Run 2 provide new opportunities to study matter produced at unprecedented temperatures and densities. In particular, the study of the azimuthal anisotropy of produced charged particles not only constrains the initial state of the nuclear collisions and soft particle collective dynamics, but also sheds light on jet quenching via the measurement of flow harmonics at high transverse momenta. In this talk, new ATLAS measurements of flow harmonics from v_2 to v_7 in Pb+Pb collisions at $\sqrt{s_{\rm NN}}$ = 5.02 TeV, performed in a wide range of transverse momenta 0.5-40 GeV, pseudorapidity ($|\eta|$<2.5) and collision centrality are presented. This includes a first measurement of v_6 and v_7, as well as harmonics in ultra-central collisions. A procedure of removing correlations arising from back-to-back jets,
recently used in *pp* collisions, is implemented in the Two-Particle Correlation method to evaluate v_n without a jet bias. The scaling relations between the v_n harmonics are also discussed.

Longitudinal dynamics has recently become a topic of great interest in the study of ultra-relativistic heavy ion collisions. Measurement of the longitudinal fluctuations of the flow harmonic coefficients v_n and event-plane angles Ψ_n can provide a more complete picture of space-time evolution of the hot, dense medium formed in heavy ion collisions. Longitudinal flow decorrelations can be modeled with two contributions: magnitude fluctuations and event plane twist. However, existing observables do not separate these two effects. In this analysis, a new 4-particle correlator is used to separate the event-plane twist from magnitude fluctuations in 2.76 and 5.02 Pb+Pb collisions. Results show both effects have a linear dependence on pseudorapidity separation for v_{2-5}, and show a small but measurable variation with collision energy. The correlation of Ψ_n of different order are also expected to have longitudinal fluctuations due to the non-linear mixing effects between lower and higher order
flow harmonics. First measurement of such non-linear mode-mixing effects as a function of pseudorapidity is also presented. These result will help to constrain initial conditions along longitudinal direction and also help understand the longitudinal evolution of the fireball.

Preferred Track

Collective Dynamics

Collaboration

ATLAS

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