Measurements of the azimuthal anisotropy of charged particles in heavy-ion collisions are sensitive to properties of the quark-gluon plasma, in particular its dependence on initial conditions, transport coefficients and time evolution. The presented measurements are based on √sNN = 5.02 TeV Pb+Pb and √sNN = 5.44 TeV Xe+Xe data collected by the ATLAS detector in 2015 and 2017, respectively. The elliptic flow and higher-order Fourier coefficients (v2 - v3) are measured for Pb+Pb and Xe+Xe collisions. The results are compared to the v4(pT) values measured in recent √sNN = 5.44 TeV Pb+Pb collisions.

**ANIZMUTHAL ANISOTROPY IN HEAVY ION COLLISIONS**

Signatures of QGP: collective expansion (radial flow, elliptic flow, ...), jet quenching, etc.

**SCALAR PRODUCT (SP) METHOD**

**Flow vector**

\[ Q_n = \left| Q_n \right| e^{i\phi_n} = \frac{1}{S} \sum_j q_{nj} = \frac{1}{S} \sum_j w_j e^{i\phi_j} \]

**Flow vectors are measured in sub-events**

- ID → sum over charged tracks, S
- FCal N and FCal P → sum over calorimeter towers

**Final formula:**

\[ v_n(SP) = \frac{\left| Q_n \right| \left| Q_n^{NP} \right| \cos(n(\phi_n - \phi_n^{NP}))}{\sqrt{\left| Q_n \right|^2 \left| Q_n^{NP} \right|^2 \cos(n(\phi_n - \phi_n^{NP}))}} \]

**Large eta gap (|η| > 3.2) to suppress short-range correlations**

**Scalar Product:** unambiguous measurement of \( v_n \) → always (\( v_n \))

**Standard Event Plane method used to compare to results obtained at lower energy as well to other experiments**

**RESULTS**

- Flow harmonics measured for \( n = 2-7 \)
- All centrality intervals show:
  - Rapid rise of \( v_2(p_T) \) up to \( p_T \sim 3 \) GeV
  - Decrease out to 7-8 GeV
  - Weak \( p_T \) - dependence above 9-10 GeV
  - The biggest asymmetry observed in mid-central collisions (30-50%)
  - Elliptic flow is dominant asymmetry, except for the most central bin 0-5%

- \( v_2 \) is dominant and remains positive at high \( p_T \)
- \( v_n \) are comparable between the Xe+Xe [1] and Pb+Pb [2]

**SUMMARY**

- The azimuthal anisotropy of charged particles in Pb+Pb collisions at 5.02 TeV was studied in wide \( p_T \) (0.5 < \( p_T < 20 \) GeV) and centrality (0-80%) ranges.
- The first ATLAS measurement of flow harmonics, \( v_n \), obtained with Xe+Xe collisions at 5.44 TeV is presented.
- Significant values of the second-order harmonic, \( v_2 \), persist up to \( p_T = 20 \) GeV, in both Pb+Pb and Xe+Xe systems.
- The flow in heavy ion collisions shows stronger dependence on the initial geometry rather than on the number of sources.