Measurement of the jet-particle v_2 in p–Pb and Pb–Pb collisions at 5.02 TeV with ALICE at the LHC

Siyu TANG for the ALICE Collaboration

Institute of Particle Physics, CCNU, Wuhan, China

Laboratoire de Physique de Clermont, CNRS/IN2P3, Clermont-Ferrand, France

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Physics Motivation

Anisotropic flow

$$E\frac{d^3N}{d^3p} = \frac{1}{2\pi}\frac{d^2N}{p_T\,dp_T\,dy}\left(1 + \sum_{n=1}^{\infty} 2v_n\cos(n(\varphi - \Psi_n))\right)$$

Flow coefficients $\quad v_n = <\cos(n(\varphi - \Psi_n))>$

n=2, elliptic flow

Elliptic flow in heavy-ion collisions::
- Low p_T and intermediate p_T: collective hydrodynamic evolution
- High p_T: path-length dependent parton energy loss in the QGP medium

High-p_T particle and jets

In Pb–Pb collisions
- Consistent jet v_2[1] and high-p_T charged-particle v_2 interpreted by jet-quenching

In p–Pb collisions
- Non-zero v_2 is observed at high p_T[2], while no jet-quenching effect is observed in small collision system (R_{pPb}[3], hadron-jet correlation[4]…)
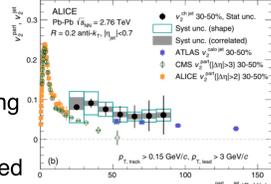
The v_2 of particles produced in jets is measured:
- lower p_T can be accessed
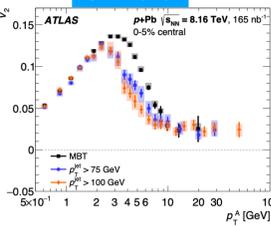- further separation of hard and soft components in collectivity in small collision system

[1] JHEP 1811 (2018) 013
[2] Phys. Lett. B 783 (2018) 95
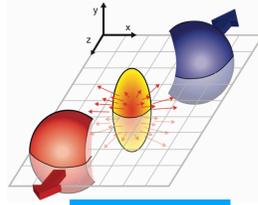
Phys.Lett. B 753 (2016) 511-525

Phys. J. C 80 (2020) 73

ALICE Detector

- **Forward Multiplicity Detector (FMD)**
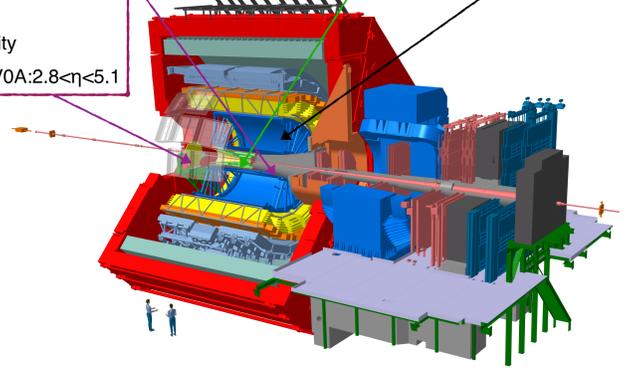 - FMD3: -3.4<η<-1.7, FMD1&2: 1.7<η<5.1

- **V0**
  - Trigger and centrality
  - V0C:-3.7<η<-1.7, V0A:2.8<η<5.1

Inner Tracking System (ITS)
- vertexing and tracking, |η| < 0.9

Time Projection Chamber (TPC)
- Tracking of charged particles

Data Sample:

Pb–Pb, $\sqrt{s_{NN}}$ = 5.02 TeV, 2015
Minimum bias triggered events ≈ 60M

p–Pb, $\sqrt{s_{NN}}$ = 5.02 TeV, 2016
Minimum bias triggered events ≈ 520M

Analysis Procedure

Extraction of jet yield

- Two-particle correlations to isolate the particles from near-side jet peak,
  - Same-sign charged particles at midrapidity (|η|<0.8) selected as trigger and associated particles
- Double Gaussian function is introduced to fit the jet signal, the sum of flow harmonics is used to fit the background
- Jet signal and background are extracted separately to calculate S and B


Fit jet signal (S) · Fit background (B) · Data
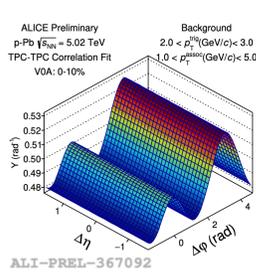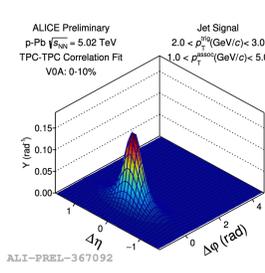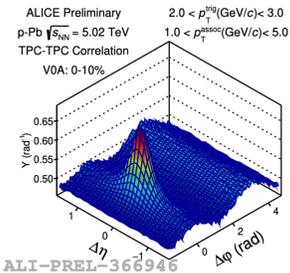
### Extraction of jet-particle v_2

- For each $(\Delta\varphi, \Delta\eta)$ region, the v_2 of trigger particle in particle pairs can be calculated
- **p–Pb: three-particle correlation**
  - Construct long-range correlation with forward rapidity particles detected in the FMD
  - Non-flow contribution is suppressed by subtraction of scaled low-multiplicity event
  - Factorization
- **Pb–Pb: Scalar product method**
  - Based on the measurement of Q-vector at forward and midrapidity
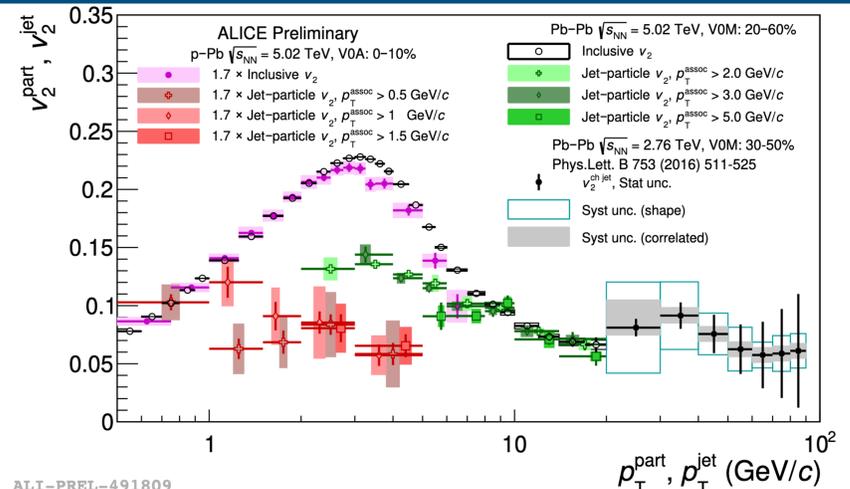 - Non-flow contribution is suppressed by applying $|\Delta\eta| > 2$
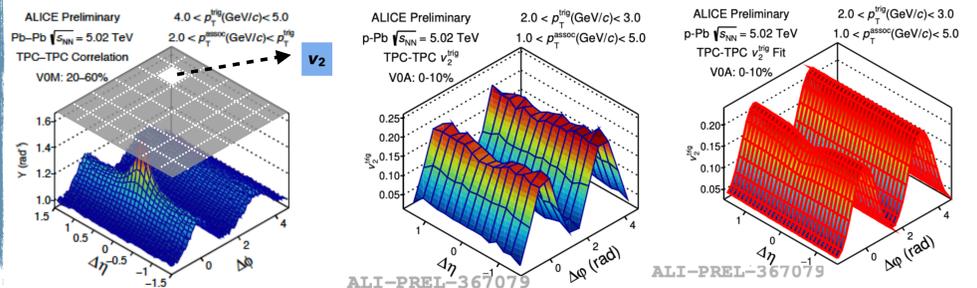
- The S and B (jet/background) is used for the fit of $v_2(\Delta\varphi,\Delta\eta)$ in each p_T interval :
  - $v_2(\Delta\varphi,\Delta\eta)$ = S/(S+B) × v_2(Jet) + B/(S+B) × v_2(Background)

Results
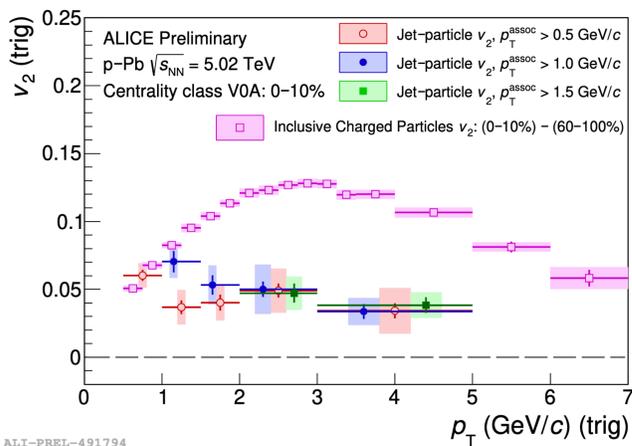
- Positive v_2 of particles in jets significantly lower than the inclusive v_2 of charged particles, is **firstly** observed in p-Pb collisions at LHC
- Consistent v_2 is observed with different associated-particle p_T selection

- In Pb–Pb collisions, jet-particle v_2 at high p_T is consistent with the reconstructed-jet v_2
- v_2 of jet particles in p–Pb collisions is consistent with jet-particle v_2 and inclusive v_2 in Pb–Pb at high p_T

Summary and Outlook

- First measurement of v_2 of jet particles in p–Pb and Pb–Pb collisions
- Positive jet-particle v_2 in p–Pb collisions is observed, comparable with the high-p_T inclusive and jet-particle v_2 in Pb–Pb collisions
  - No dependence on associated-track p_T within uncertainties
- Comparison to AMPT models included final-state interactions will be provided