Constraining the CMW with ESE in Pb-Pb 2.76 TeV

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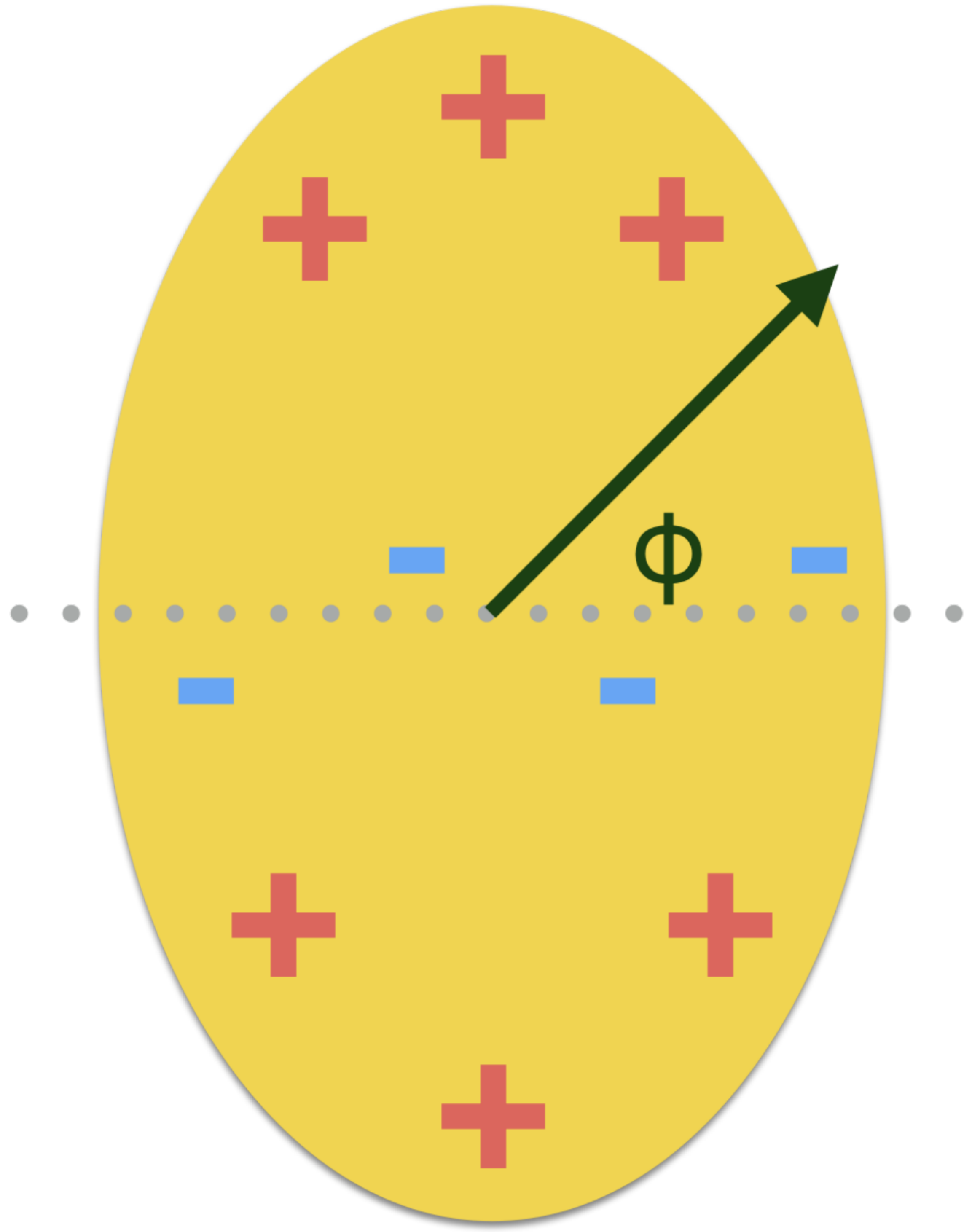
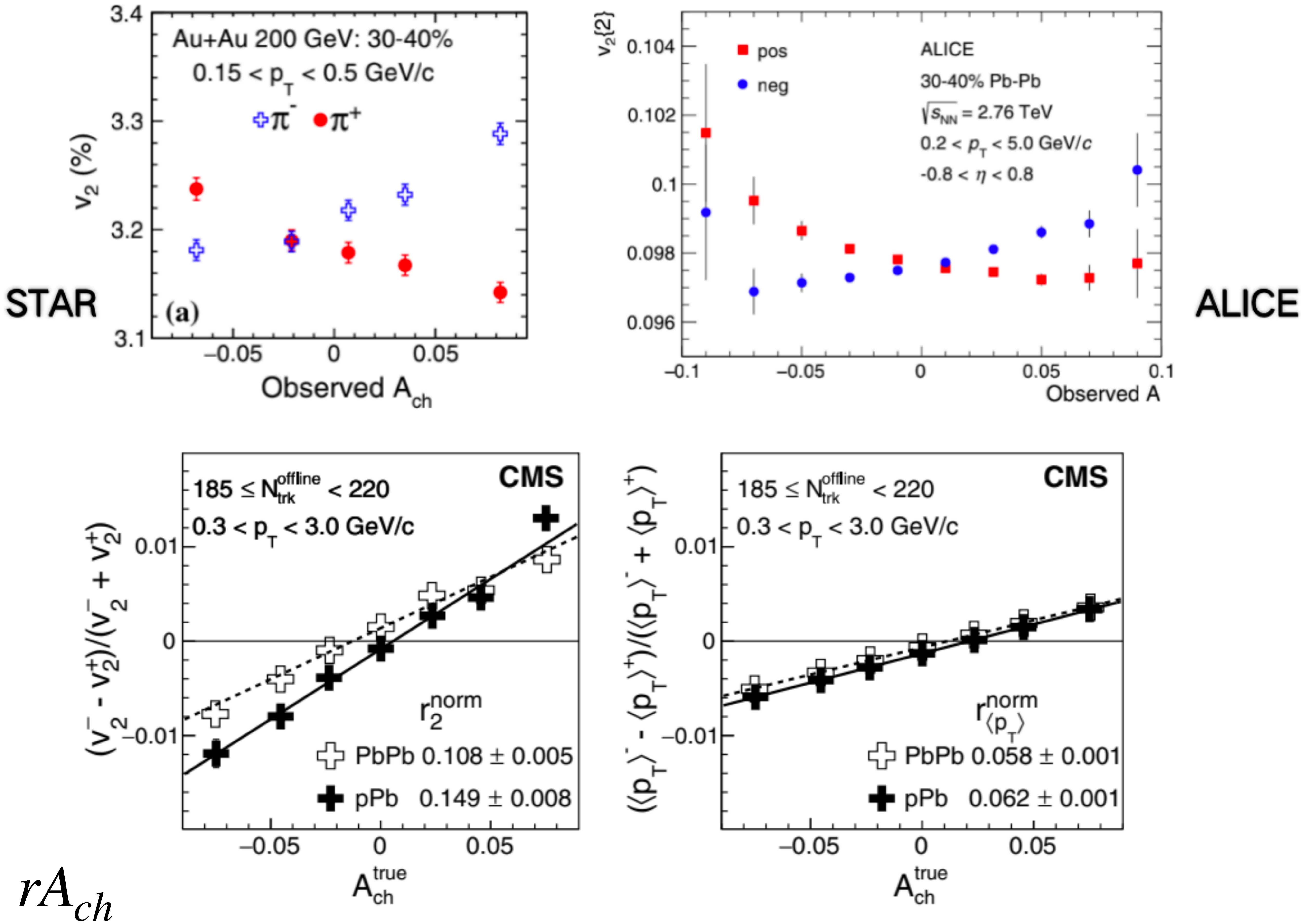
CMW and LCC background





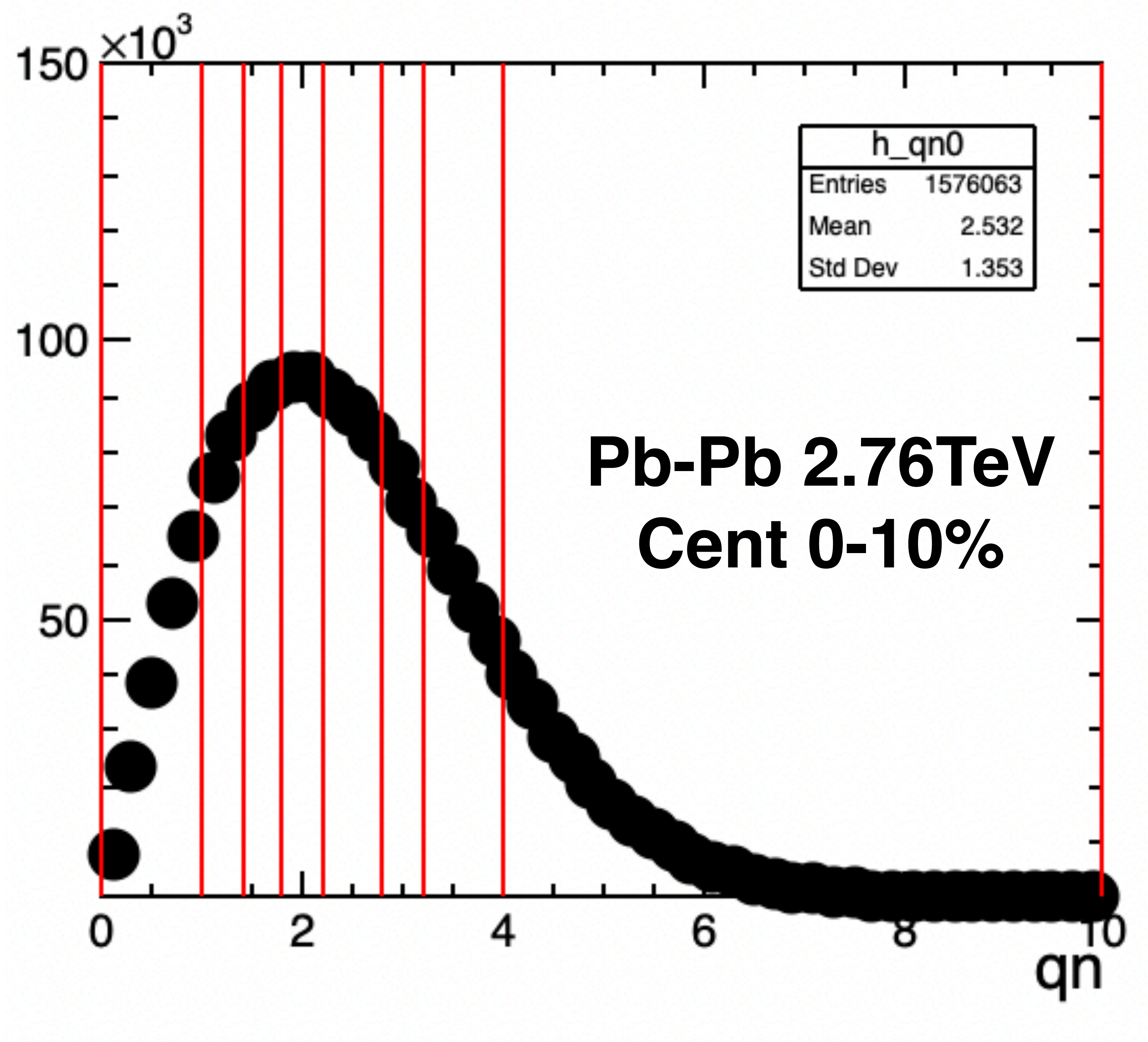
- CMW → electric quadrupole momentum
  → A_{ch} dependent v_2
- Experimental observable : $\Delta v_2 \equiv v_2^- - v_2^+ \simeq rA_{ch}$
- Linear dependence for $\Delta\langle v_2\rangle - A_{ch}$ can't reflect the charge separation
- LCC — most important background in CMW research!

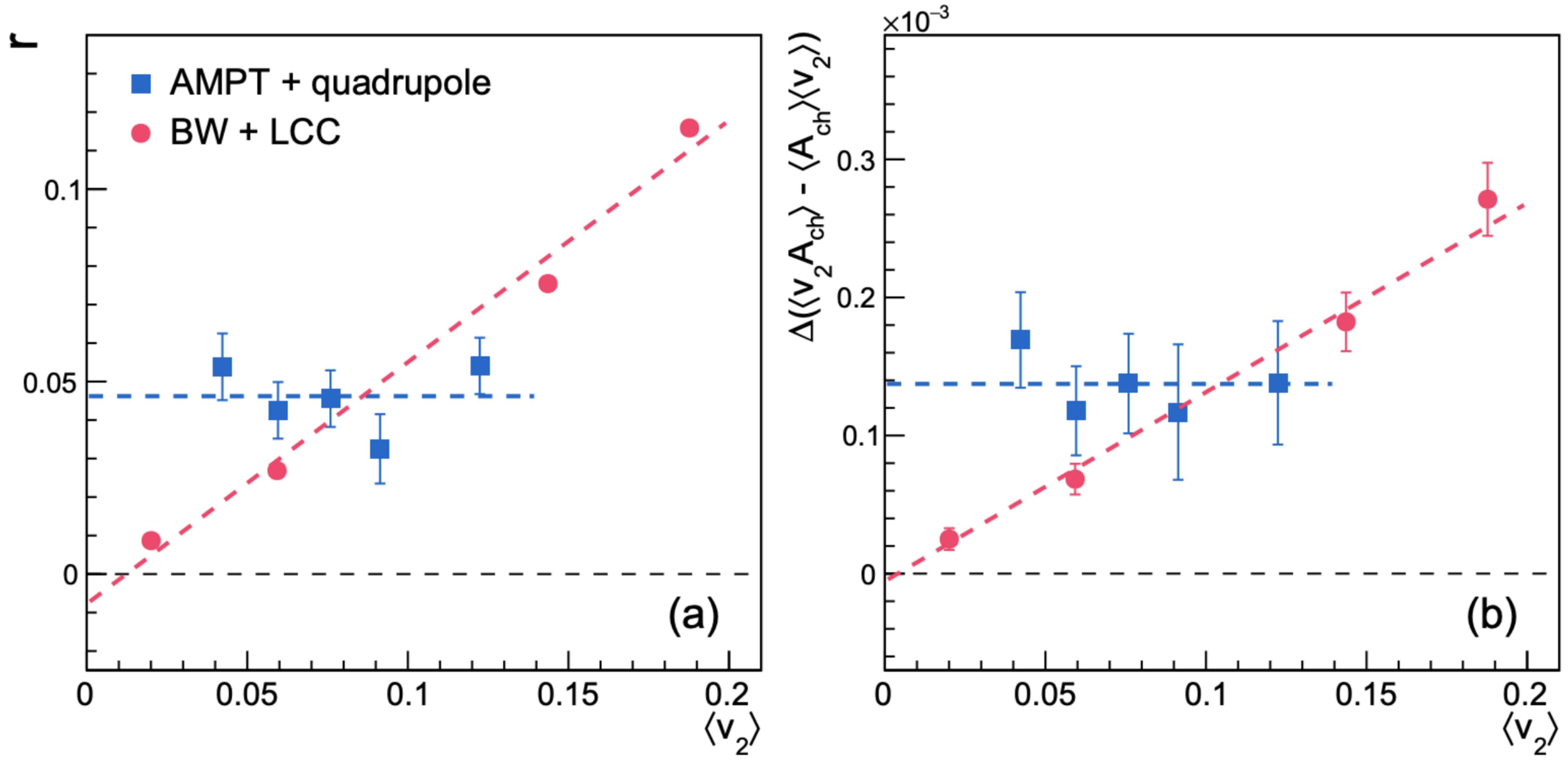
$$Ach = < \frac{N_+ - N_-}{N_+ + N_-} >$$

Event Shape Engineering

$$Q_{n,x} = \sum_{i}^{M} \cos(n\phi_i), \quad Q_{n,y} = \sum_{i}^{M} \sin(n\phi_i)$$

$$q_n = Q_n/\sqrt{M}$$





C. Z. Wang, W. Wu. et al. arXiv:2104.05551v1

- Qn is estimated with V0M (will cross check TPC)
- Investigate the **slope** parameter in 10 qn bins
- **Integral Covariance** is better than slope in this sense

Model results & Key idea：

Bkg (Blast wave + LCC): observable linearly depends on v_2 (sensitive to ESE)

Sig (AMPT + quadrupole): constant

Bkg + Signal: $b + a_{Bkg} v_2 = F_{data}(v_2)$

Data Set and Cuts

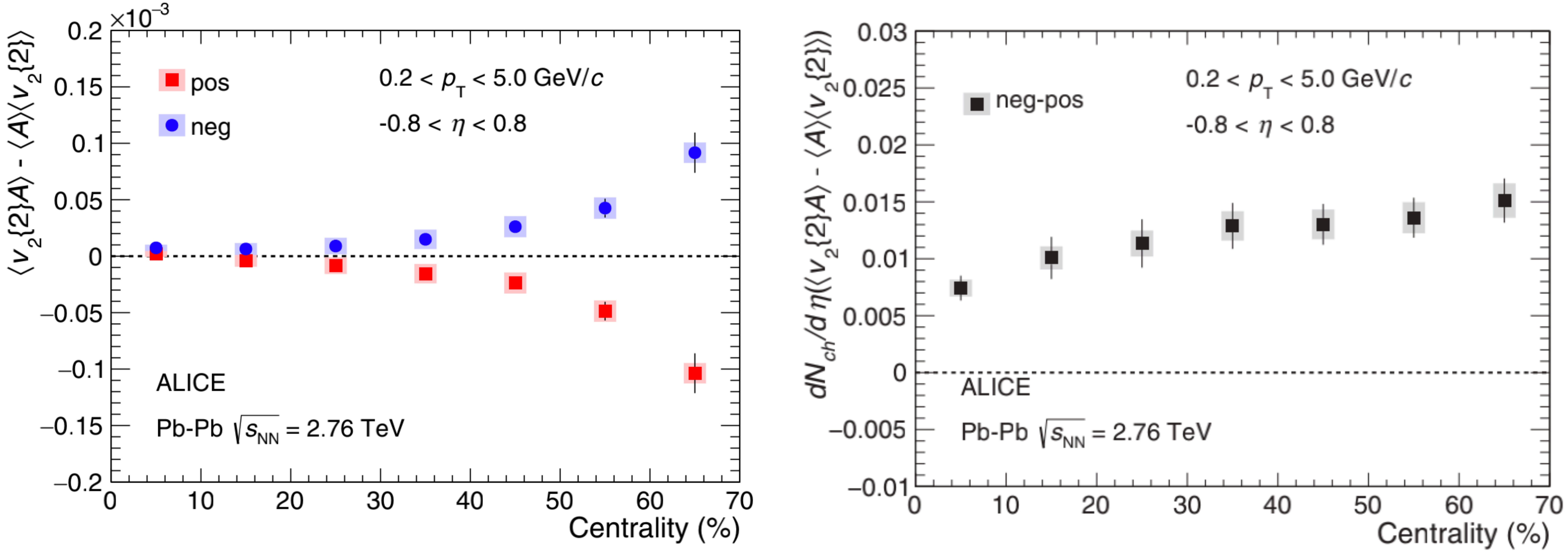
Collision system	Pb-Pb
Data Peroid	LHC10h
Energy	2.76 TeV
No. of events	~12M(LHC10h)
MC data (for NUE correction)	LHC12a17a fix
Event Cuts	|vz|<10, pileup removal
Track Cuts	FB 1, nhits>70, 0.1<chi2<4
Trigger	kMB+kCentral+kSemiCentral
Centrality	V0M
Qn-vector	V0C

Integral Covariance between v_2 and A_{ch}

Integral three-particle correlator:

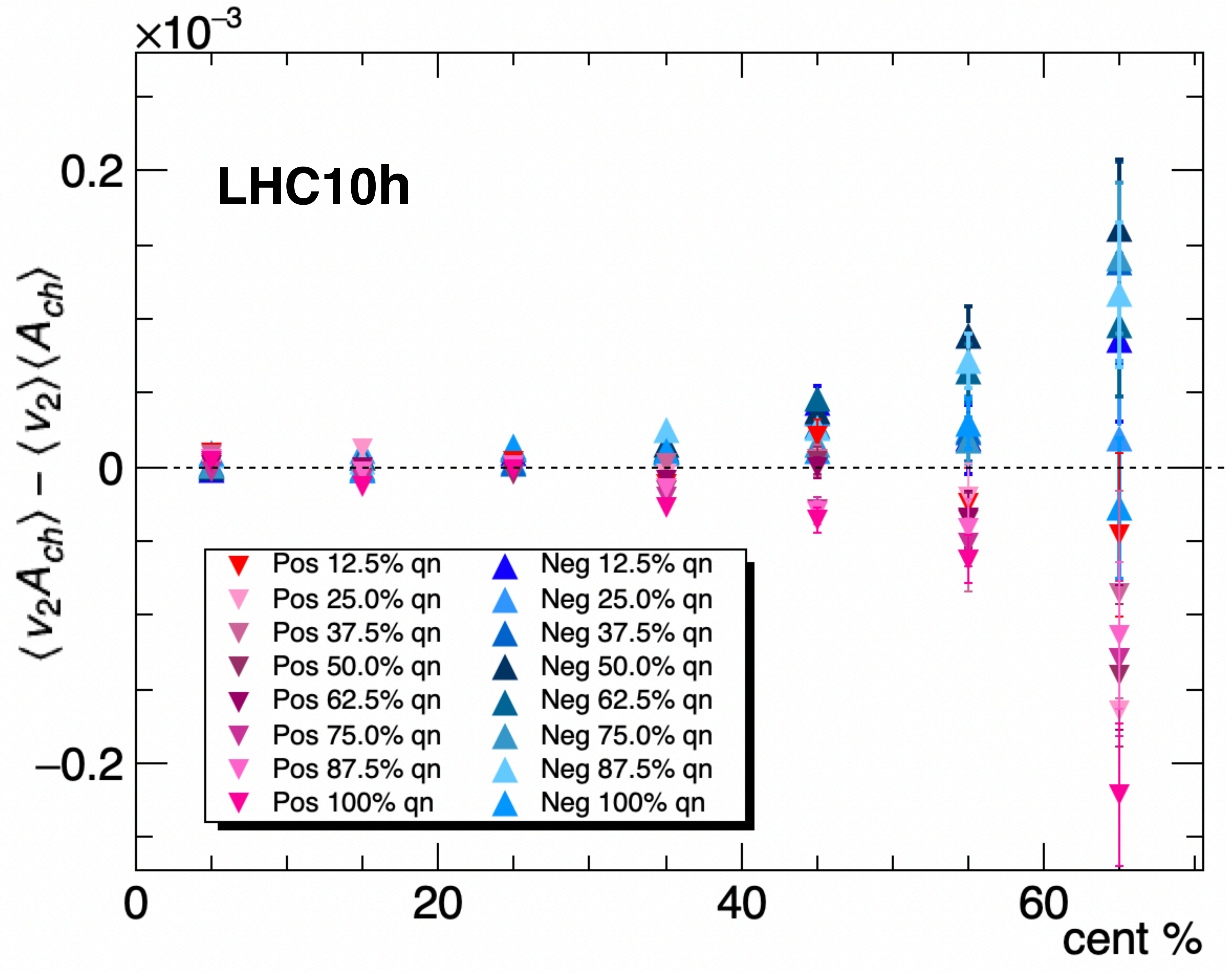
$$\left\langle v_2^{\pm} A \right\rangle - \langle A \rangle \left\langle v_2^{\pm} \right\rangle \approx \mp r\sigma_A^2/2; \quad v_2^{\pm}\{2\} = d_2\{2\}/\sqrt{c_2\{2\}}$$

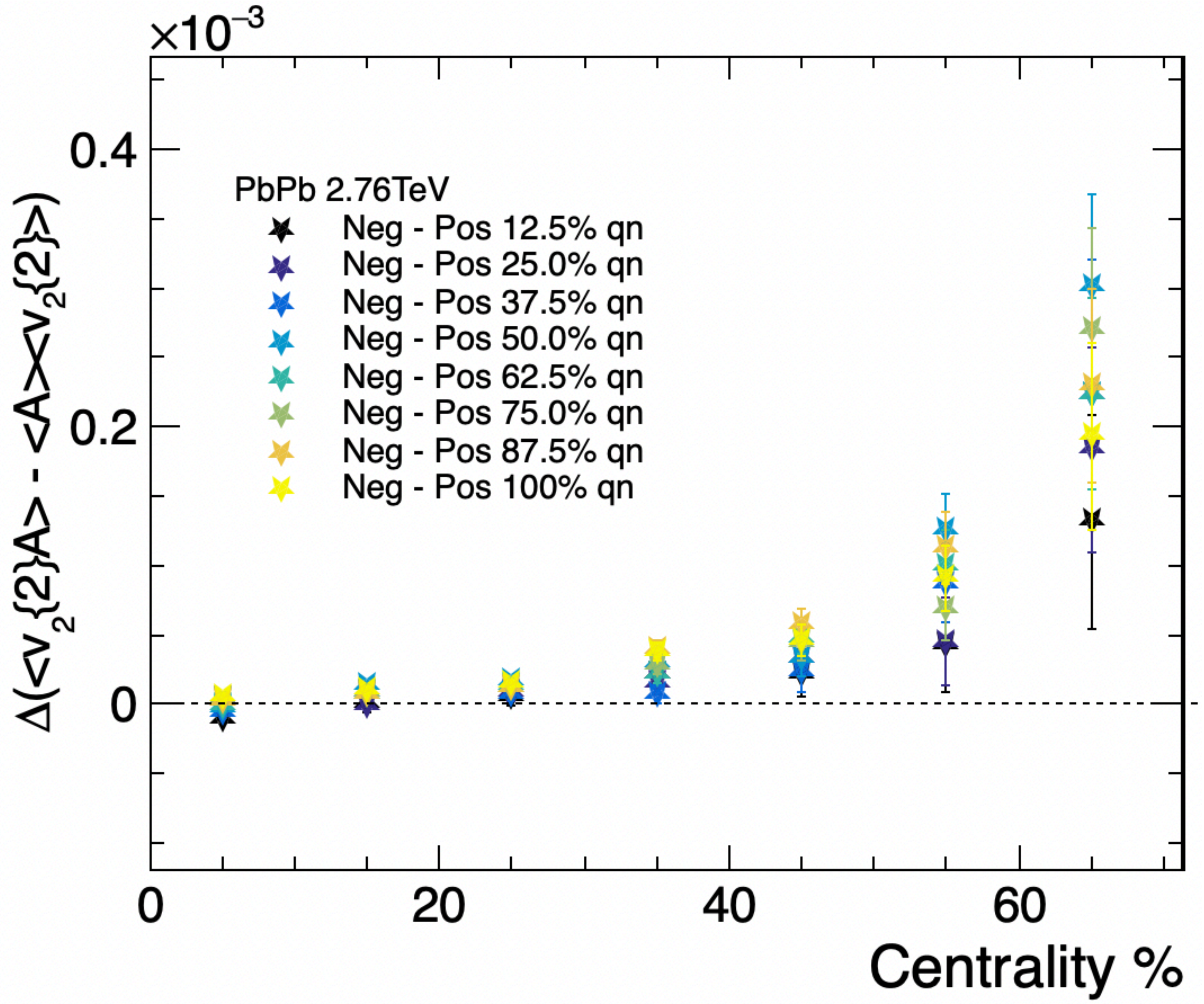
where v_2 is calculated in QCumulants method (subEvent gap = 0.3). Same as ALICE(2016) paper



ALICE(2016)

Integral Covariance Vs. Centrality





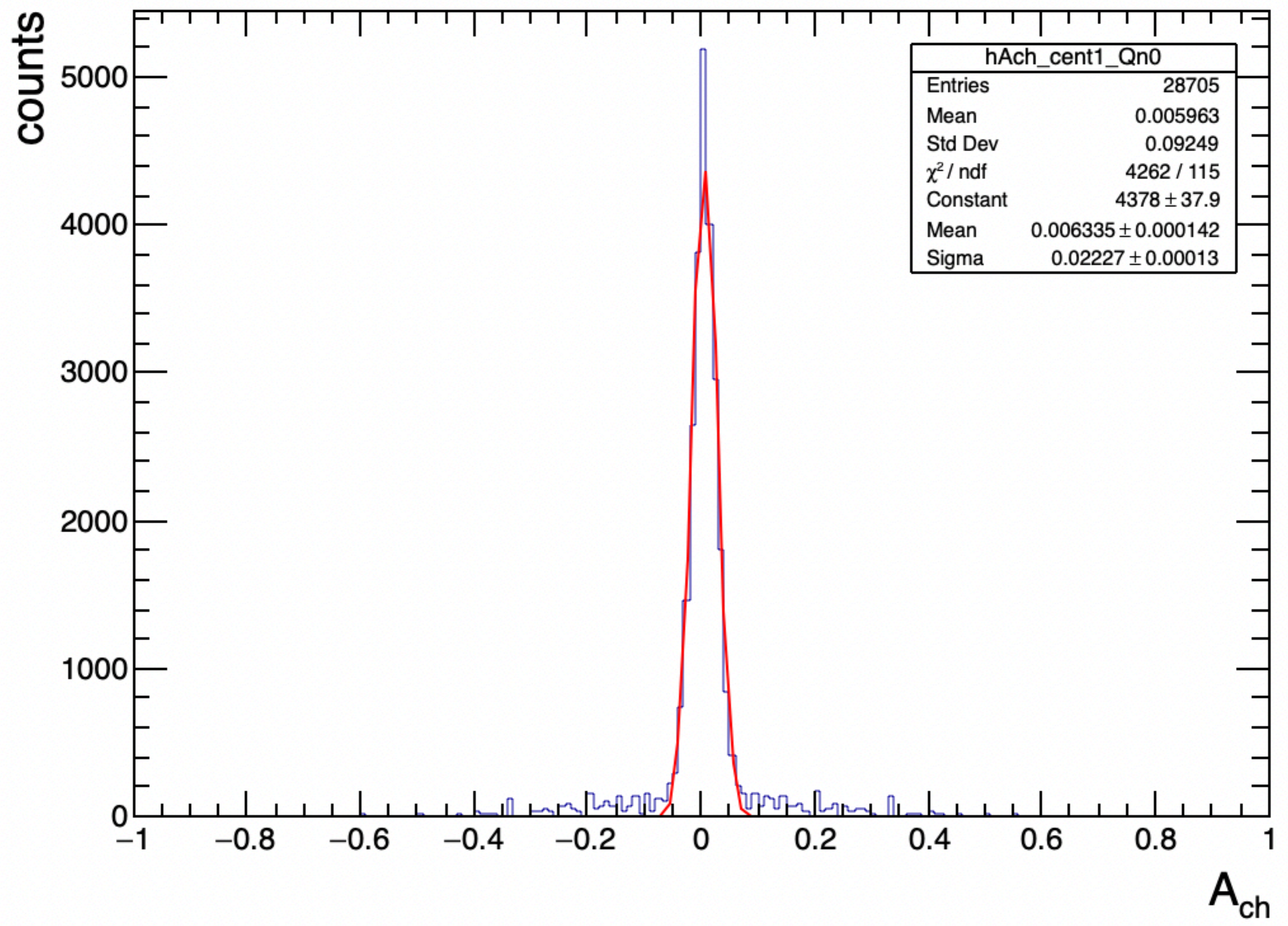
- Splitting of Integral Covariance
- Higher qn -> larger cov.
- qn is not corrected by recentering

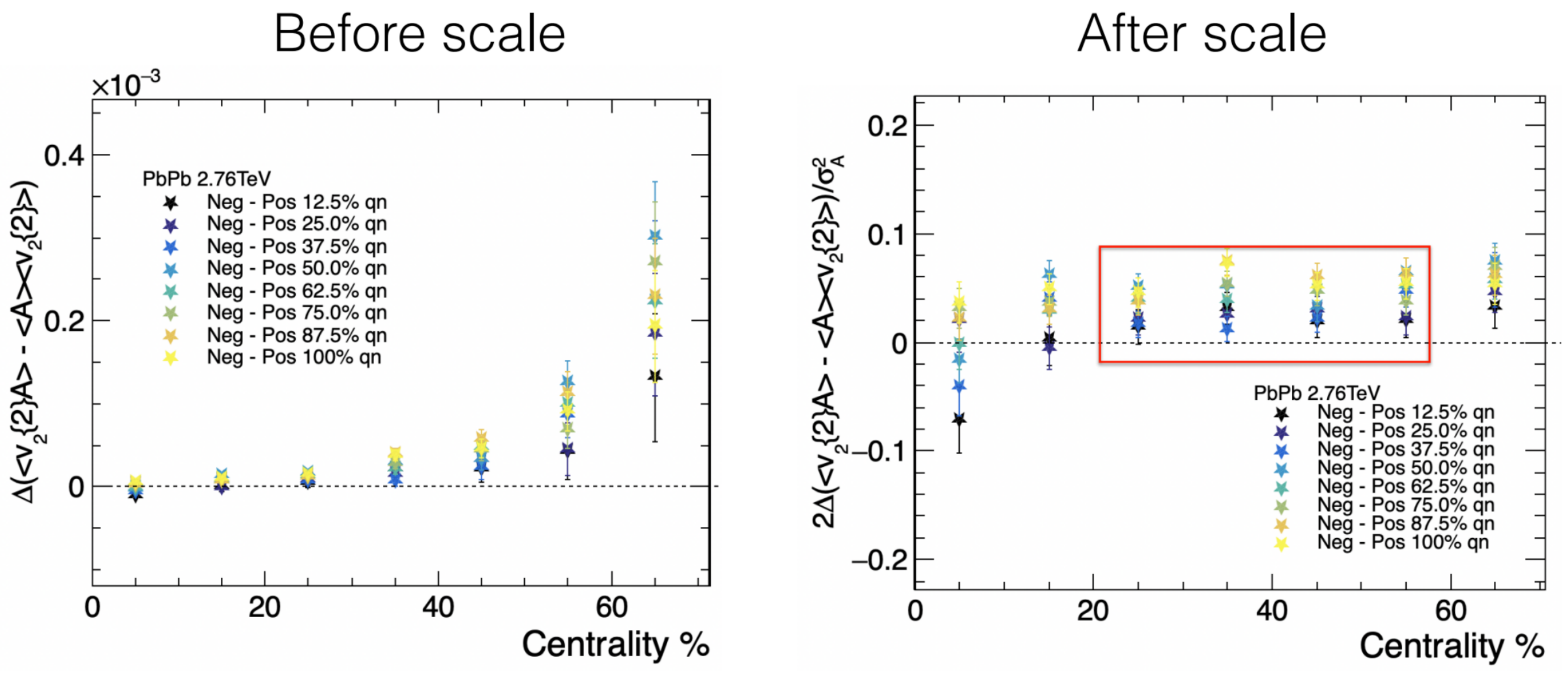
Scale with $2/\sigma_A^2$

- There's a factor between the slope and the integral covariance characterized by σ_A^2 (or $dN_{ch}/d\eta$)
- σ_A^2 is the width of the A_{ch} distribution (fitted by gaus)
- Scale with $2/\sigma_A^2$
- A_{ch} distribution should be calibrated

Slope of v_2 Vs. A_{ch}

$$\langle v_2^{\pm} A \rangle - \langle A \rangle \langle v_2^{\pm} \rangle = \mp r \sigma_A^2 / 2$$



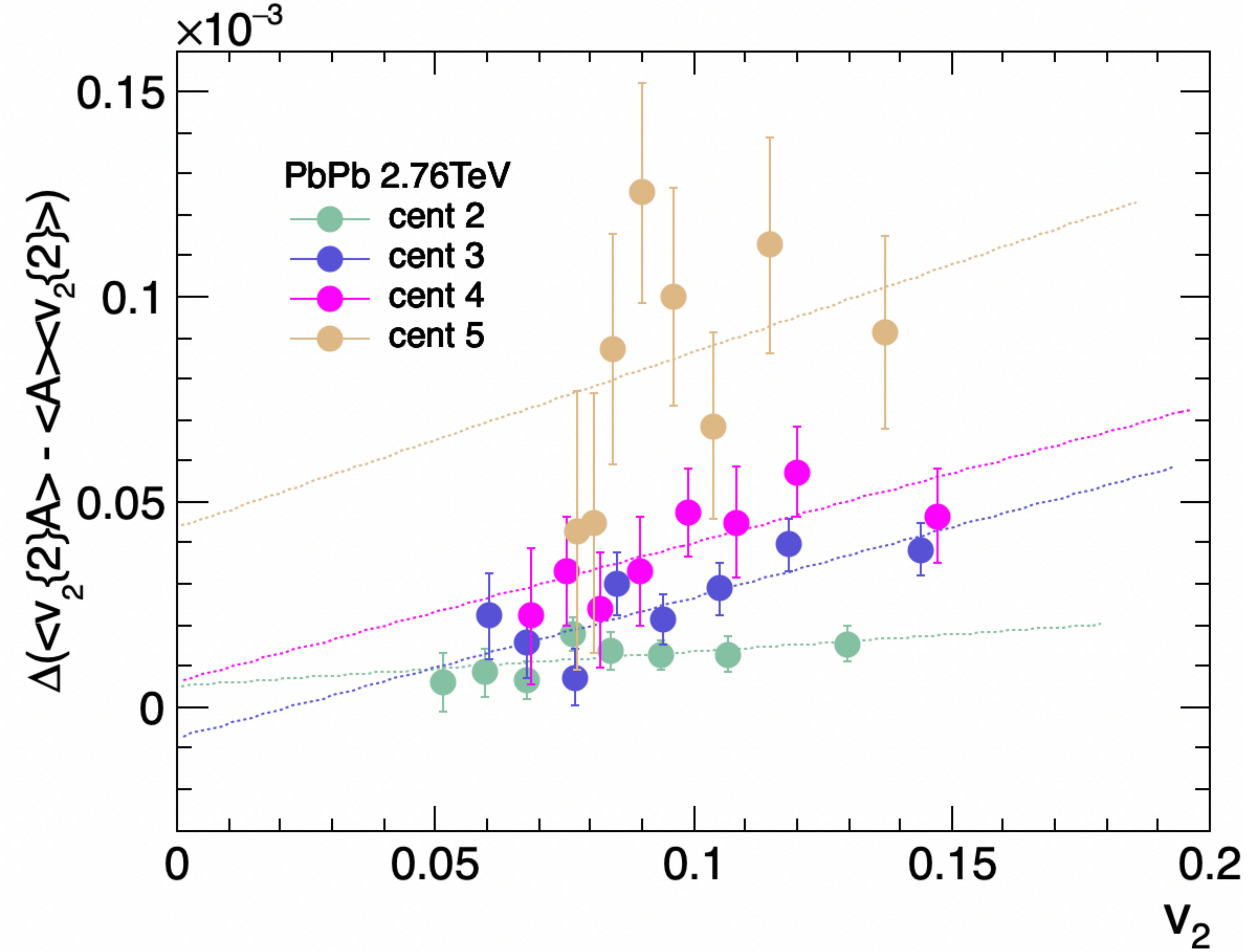


high multiplicity -> large dN/dη -> narrow Ach distribution -> small σ_A^2

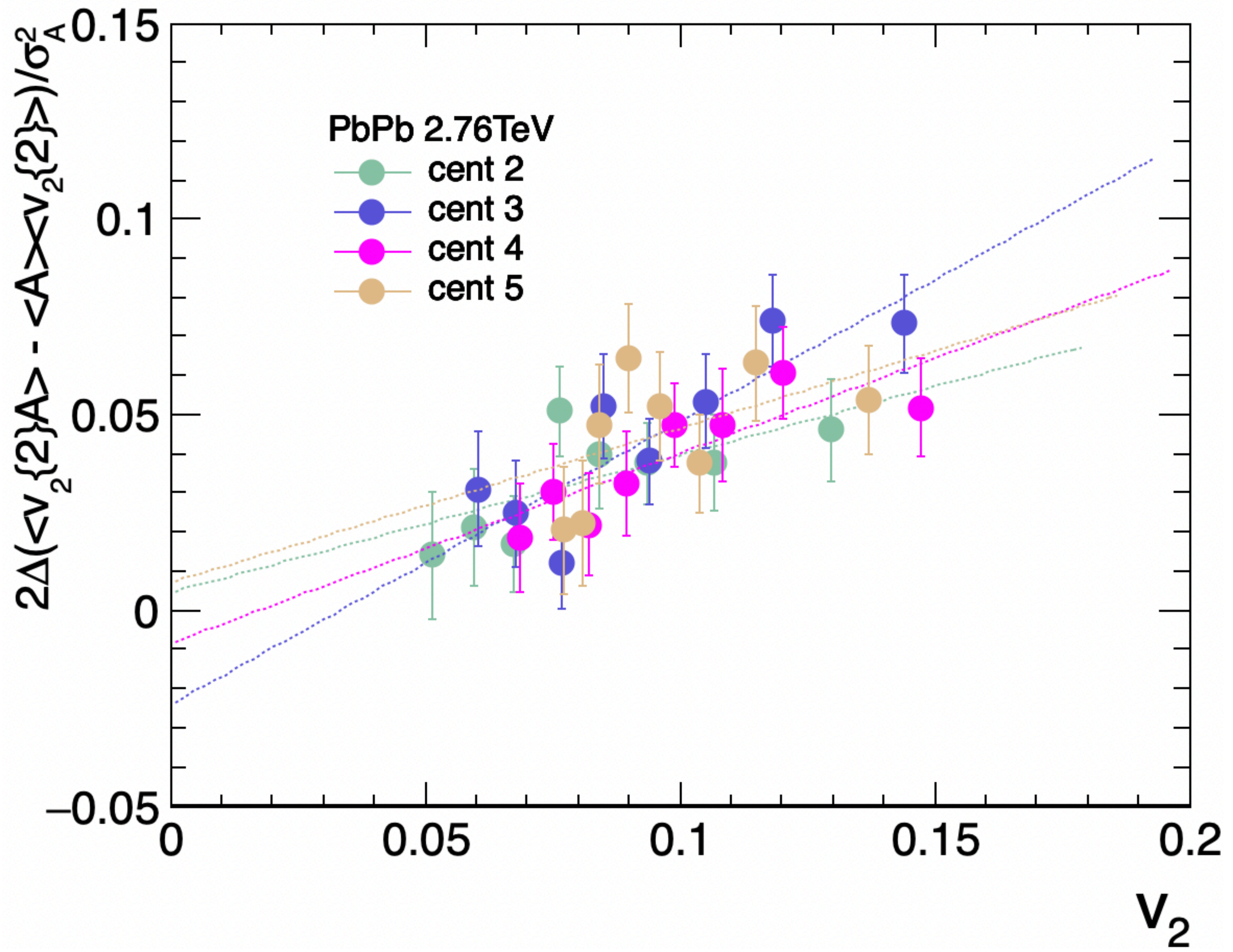
Scaled Int. Cov. shows a clear dependence on Qn in most centralities

Cov. Vs. v2

LHC10h; Before Scale

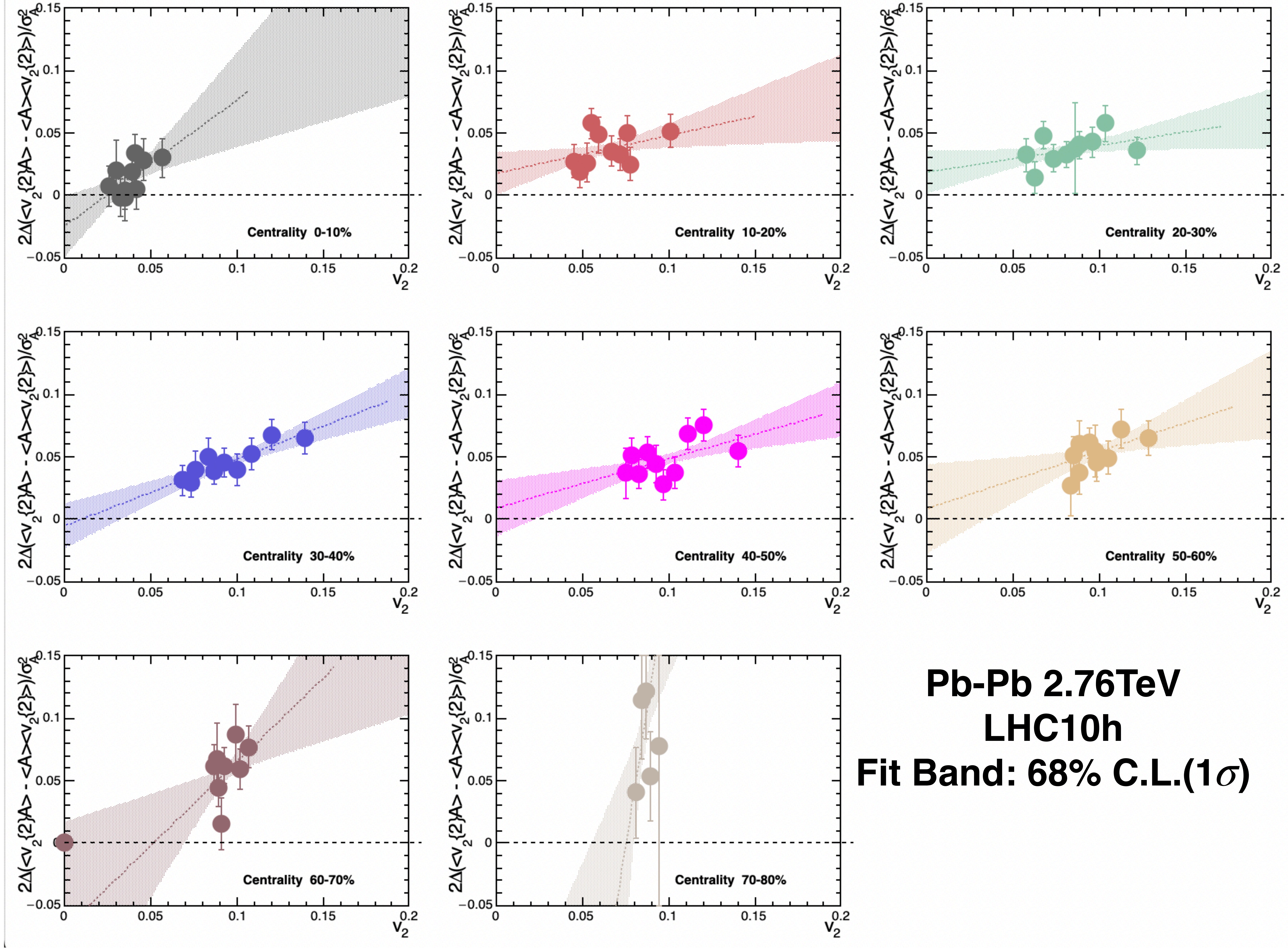


LHC10h; After Scale



- Covariance is plotted as a function of $<v_2>$
- In most centralities, cov. proportionally change with $<v_2>$. Small $<v_2>$ -> smaller cov.
- σ_A^2 is significant to correct the 'multiplicity difference' (see p6)

Cov. Vs. v2 (in different centralities)

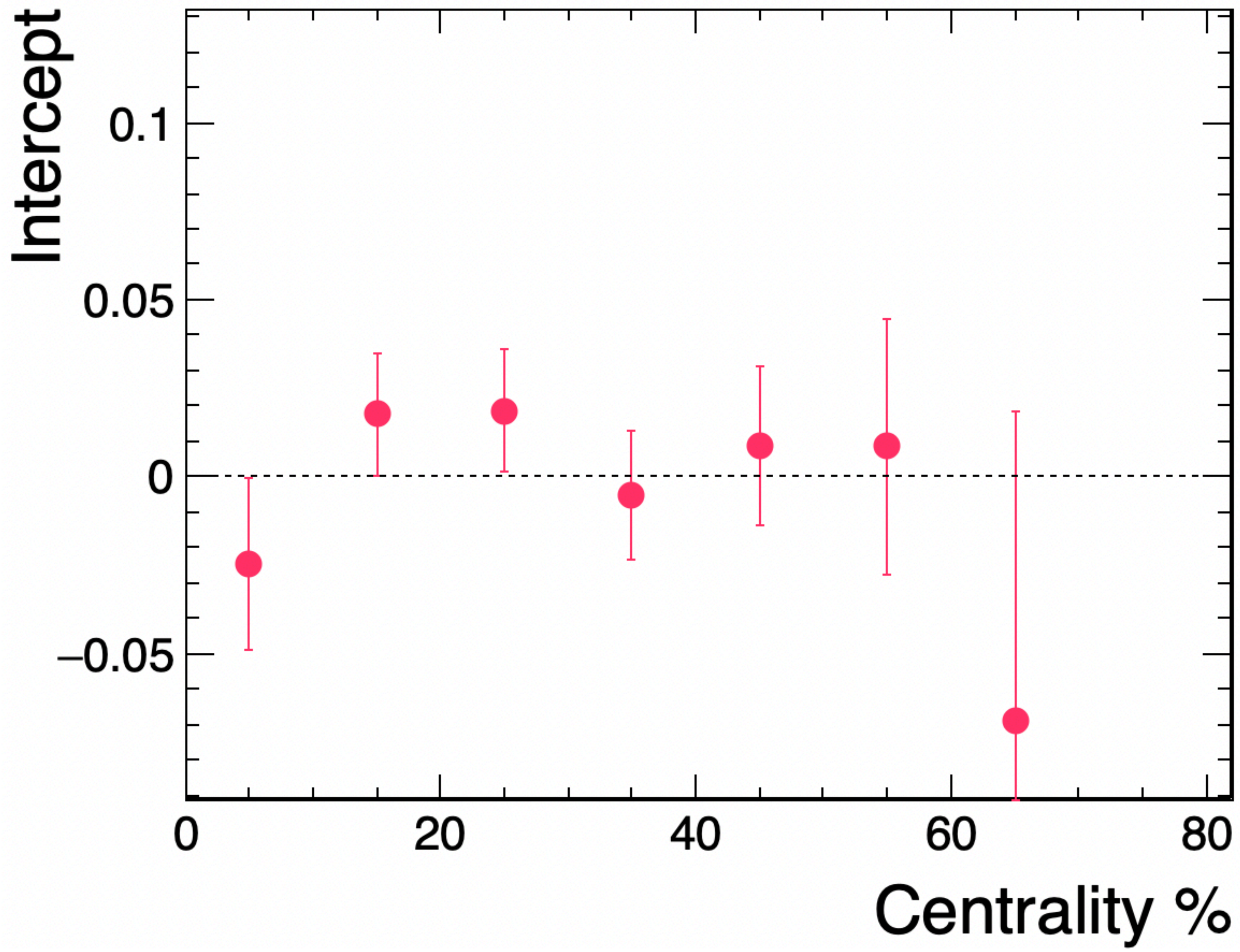


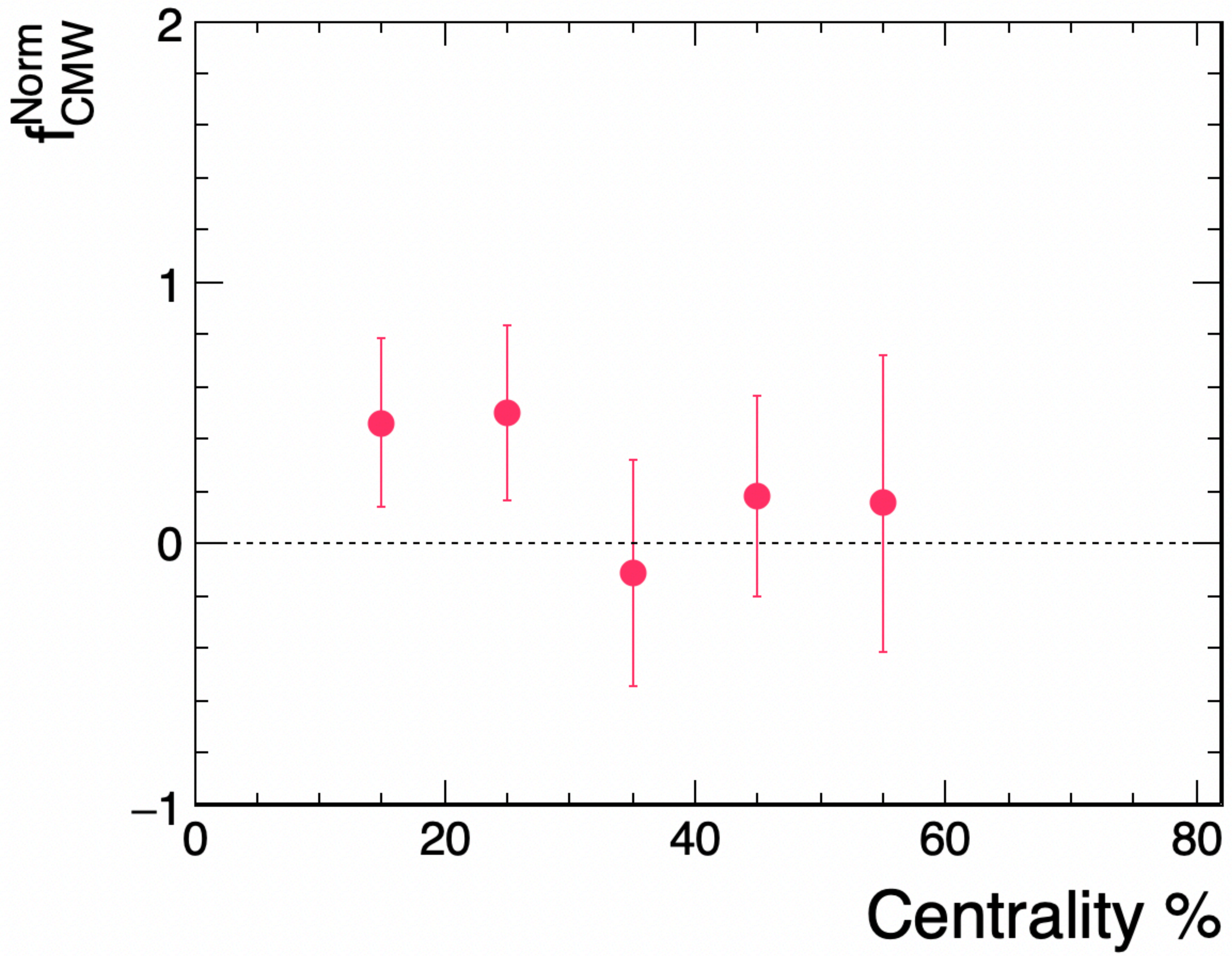
Pb-Pb 2.76TeV
LHC10h
Fit Band: 68% C.L.(1σ)

- In most centralities, cov. proportionally change with $<v_2>$. Small $<v_2>$ -> smaller cov.
- Linear fit: $F(v_2) = a \times v_2 + b$
- Intercept **b** can be used to quantify the CMW signal

Extraction of fCMW

$$f_{CMW} \equiv \frac{b}{a * \overline{\langle v_2 \rangle} + b}$$





- Intercept parameters are consistent with zero within errors in most centralities
- For those non-negative intercepts, fCMW is extracted
- Need further study to make solid conclusion.

Summary and outlook

- First attempt to extract the fraction of the CMW signal with ESE
- Clear evidence of Int. Cov. linearly depending on v_2, indicating the existence of the LCC
- Intercepts are consistent with zero within errors in most centralities
- V0 Calibration (Qn)

Outlooks

- Improving the method for ESE
- Cross check the ESE performance with TPC
- More Statistic
- Investigating the possible contributions that influence the fitting results
- Other data sets; covariance for v_3;

Thanks For Attention!