

# Impact of $\alpha$ -clustered nuclear density profiles on medium anisotropy in $pO$ and $pC$ collisions at the LHC

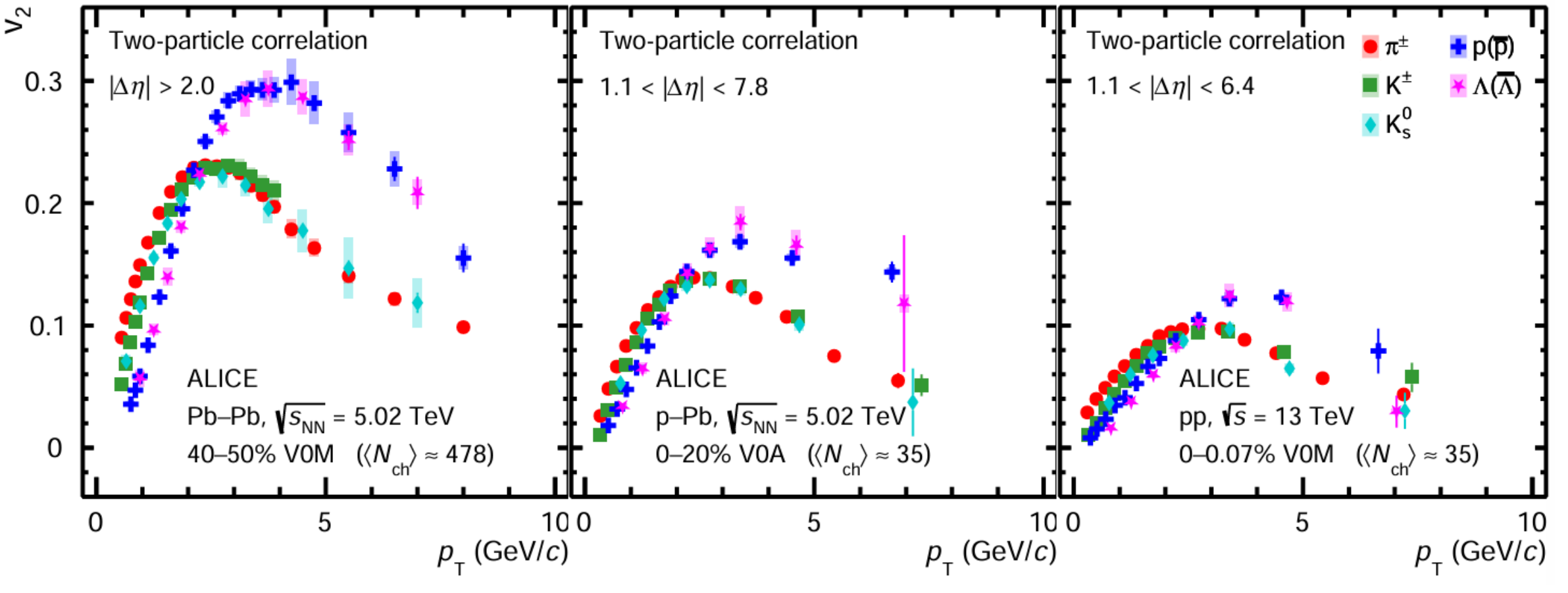
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## INTRODUCTION

Recent experimental observations of collectivity in high multiplicity  $pp$  and  $p-Pb$  collisions bring our attention to **small collision systems**



Anisotropic flow can be quantified by the Fourier coefficients in the azimuthal expansion of final-state particles as :

$$\frac{dN}{d\phi} = \frac{1}{2\pi} \left( 1 + \sum_{n=1}^{\infty} 2v_n \cos[n(\phi - \psi_n)] \right)$$

Two-particle Q-cumulant method with an appropriate pseudorapidity gap ( $\Delta\eta$ ) allows us to estimate  $v_n$  by reducing non-flow effects

## MOTIVATION

To investigate **jet-quenching effects, collective flow phenomena** in small systems like  $p-Pb$

PERFECT SYSTEM SIZE to fill multiplicity gap between  $pp$ ,  $p-Pb$  and  $Pb-Pb$

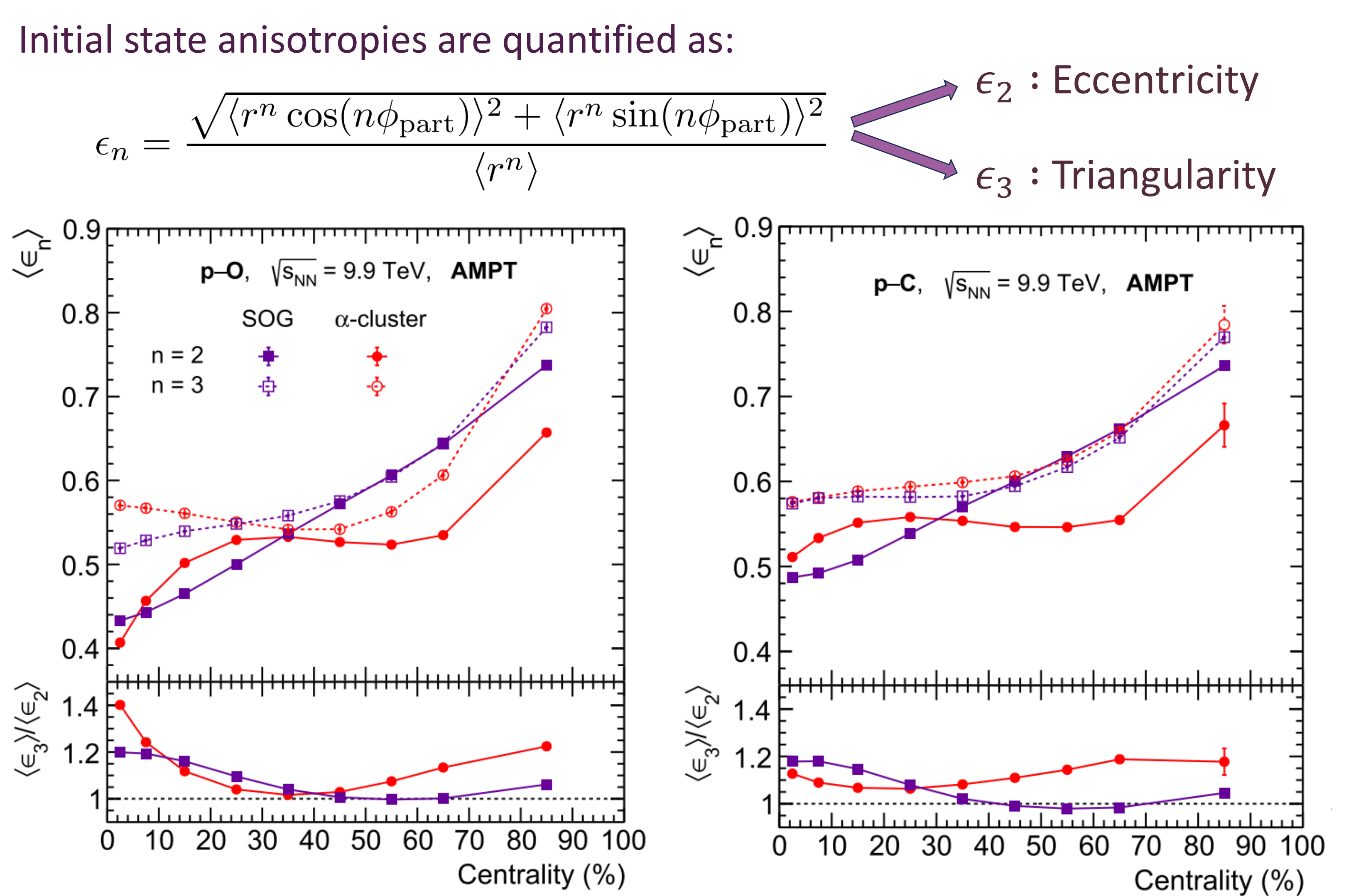
**Why  $pO$  and  $OO$  collisions at LHC ?**

$pO$  studies for cosmic air shower modelling

Effect of initial clustered geometry on final-state azimuthal correlations

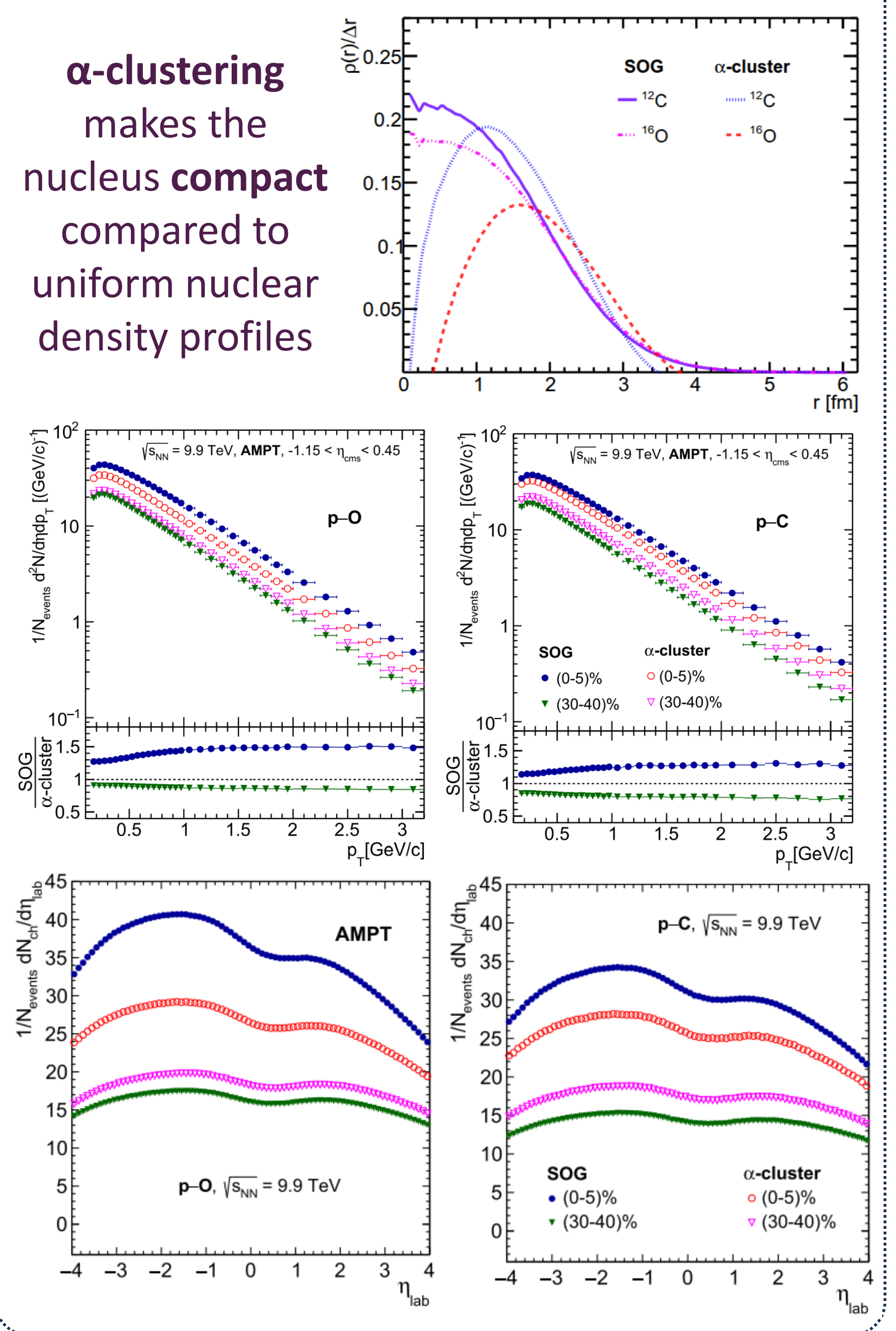
We choose  $pC$  and  $pO$  collisions to look into the possible effects of an initial  $\alpha$ -clustered nuclear geometry of  $^{12}C$  and  $^{16}O$  on the elliptic ( $v_2$ ) and triangular ( $v_3$ ) flow using AMPT model

## ECCENTRICITY and TRIANGULARITY

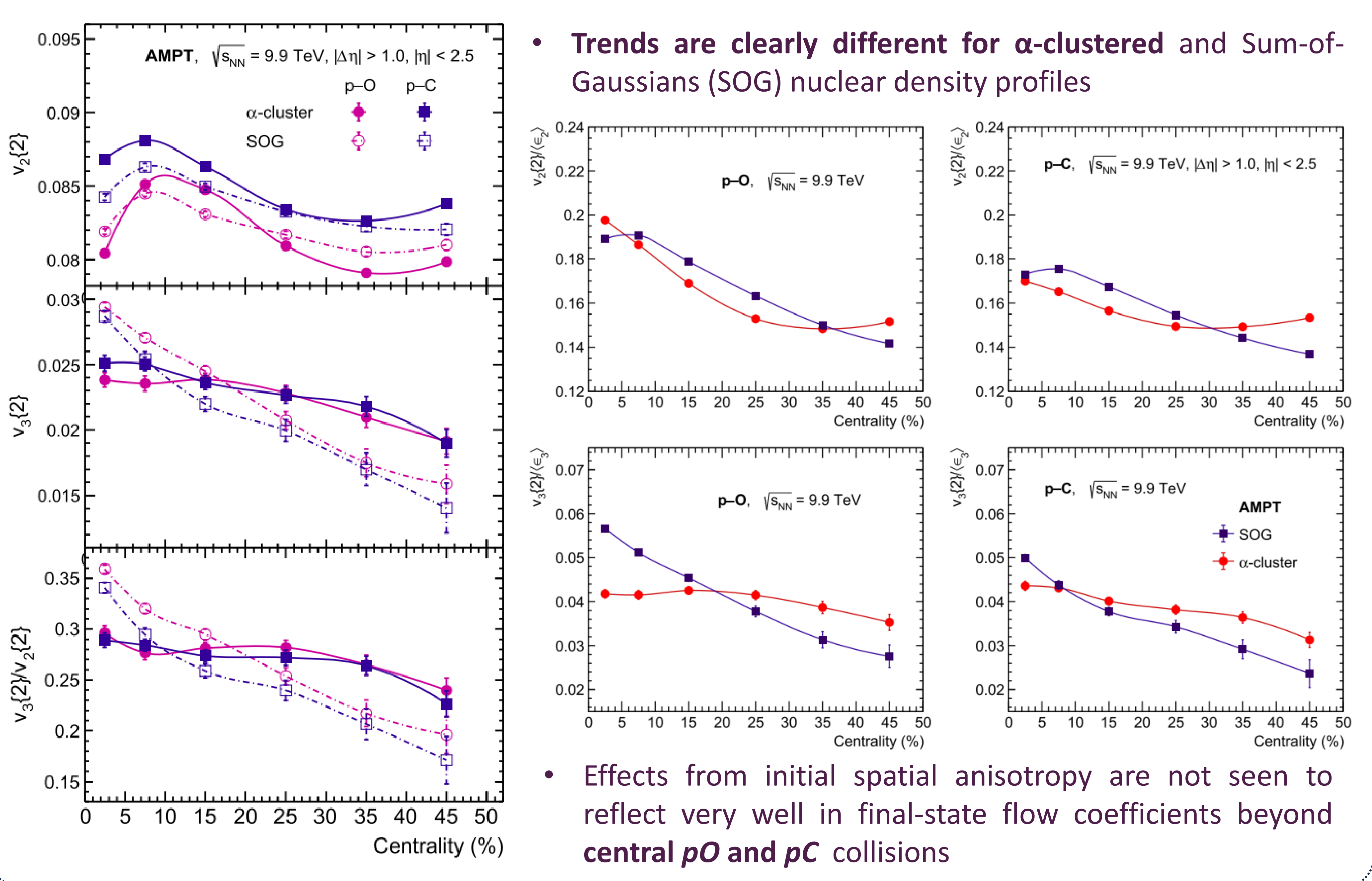


- Initial spatial anisotropy has **significant dependence on nuclear density profiles**
- Trends of  $\langle \epsilon_n \rangle$  and  $\langle \epsilon_3 \rangle / \langle \epsilon_2 \rangle$  from  $\alpha$ -clustered  $pO$  and  $pC$  collisions resemble well with that of  $\alpha$ -clustered  $OO$  collision results from AMPT

## $p_T$ and $\eta$ spectra



## ELLIPTIC FLOW ( $v_2$ ) and TRIANGULAR FLOW ( $v_3$ )



## SUMMARY

- $\alpha$ -cluster profile maintains a similar but unique qualitative behavior throughout the collision systems  $pC$ ,  $pO$  and  $OO$
- $v_3/v_2$  ratio could experimentally probe the effects due to  $\alpha$ -clustering in contrast to unclustered nuclear density profile

## REFERENCES

- A. Menon Kavumpadikkal Radhakrishnan, S. Prasad, N. Mallick and R. Sahoo, Eur. Phys. J. A 61, 134 (2025)
- D. Behera, S. Prasad, N. Mallick and R. Sahoo, Phys. Rev. D 108, 054022 (2023)
- S. Acharya et al. [ALICE], [arXiv:2411.09323]

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