Pseudorapidity dependence of anisotropic flow in Pb-Pb collisions with ALICE

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Motivation

- **Primary goal:** Measure v_n at forward rapidities with ALICE
- **Challenge:** Twice as many secondary charged particles as there are primary at forward rapidity.
- $\Delta\varphi$: Linear combination of two variables distributed by $P(\varphi)$,
$$P_\Delta(\Delta\varphi) = P(\varphi_1) \circ P(\varphi_2)$$
- **The Fourier coefficients of $P_\Delta(\Delta\varphi)$ give the harmonics v_n.**
- Secondaries (φ') distributed around the primaries smear $P_\Delta(\Delta\varphi)$ by a function $f(\varphi)$: $P(\varphi') = f(\varphi) \circ P(\varphi)$.
- Observed in the detector $\Delta\varphi' = \varphi_1' - \varphi_2$:
$$P_\Delta'(\Delta\varphi') = f(\varphi) \circ P_\Delta(\Delta\varphi)$$
If we know $f(\varphi)$, we can extract $P_\Delta(\Delta\varphi)$
- Correct for smearing of φ of secondaries by estimating the smearing per particle [3].

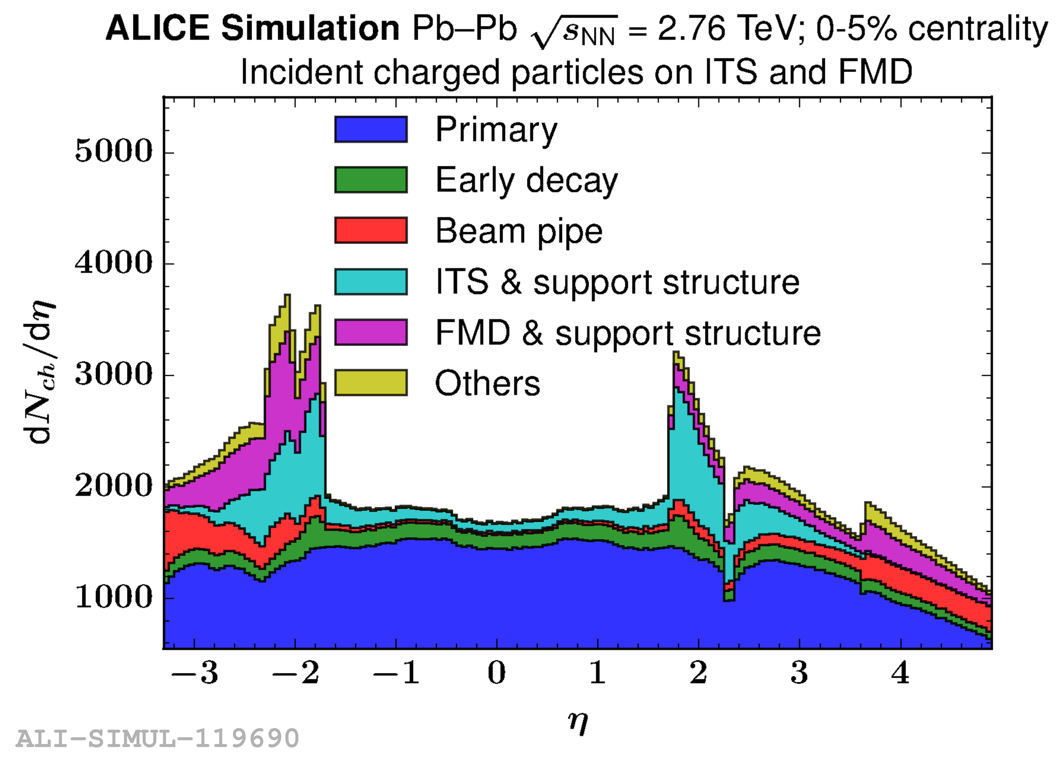

Figure: 1. Origin of particles hitting the FMD [3].

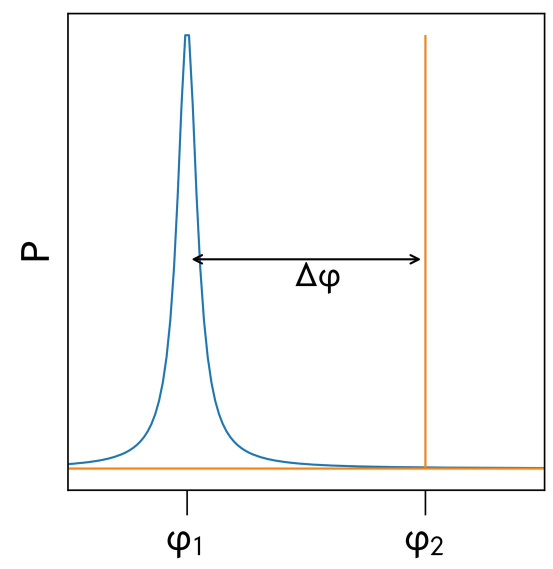

Figure: 2. Schematic of a measurement of $\Delta\varphi$. φ_1 is smeared by secondaries (measured with the FMD) and φ_2 is not smeared (measured with the TPC).

Correction Method

$f(\varphi)$ determined by the spread of secondary particles around a primary particle

f is a Cauchy (Lorentzian) distribution:

$$f(\Delta\varphi, \gamma, I) = I[\frac{\gamma^2}{\Delta\varphi^2 + \gamma^2}]$$

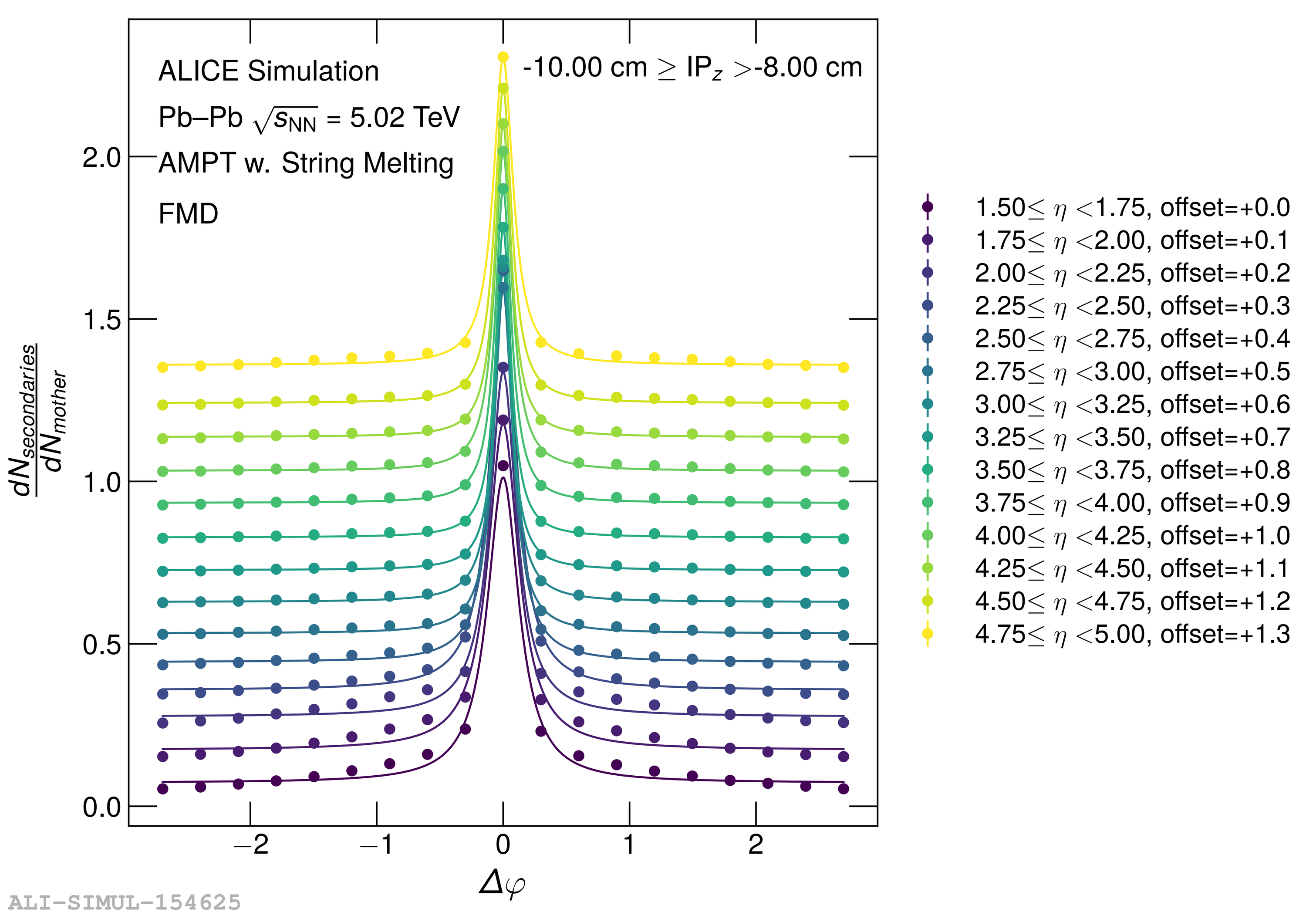

Figure: 3. The distribution of secondary particles around its primary mother particle. The offsets are artificial.

Fourier transform of Cauchy:

$$\mathcal{F}\{I[\frac{\gamma^2}{\Delta\varphi^2 + \gamma^2}]\} = I \cdot e^{-\gamma|n|}$$

The width, γ, are extracted from the fits.

Calculated Correction Factors and Application

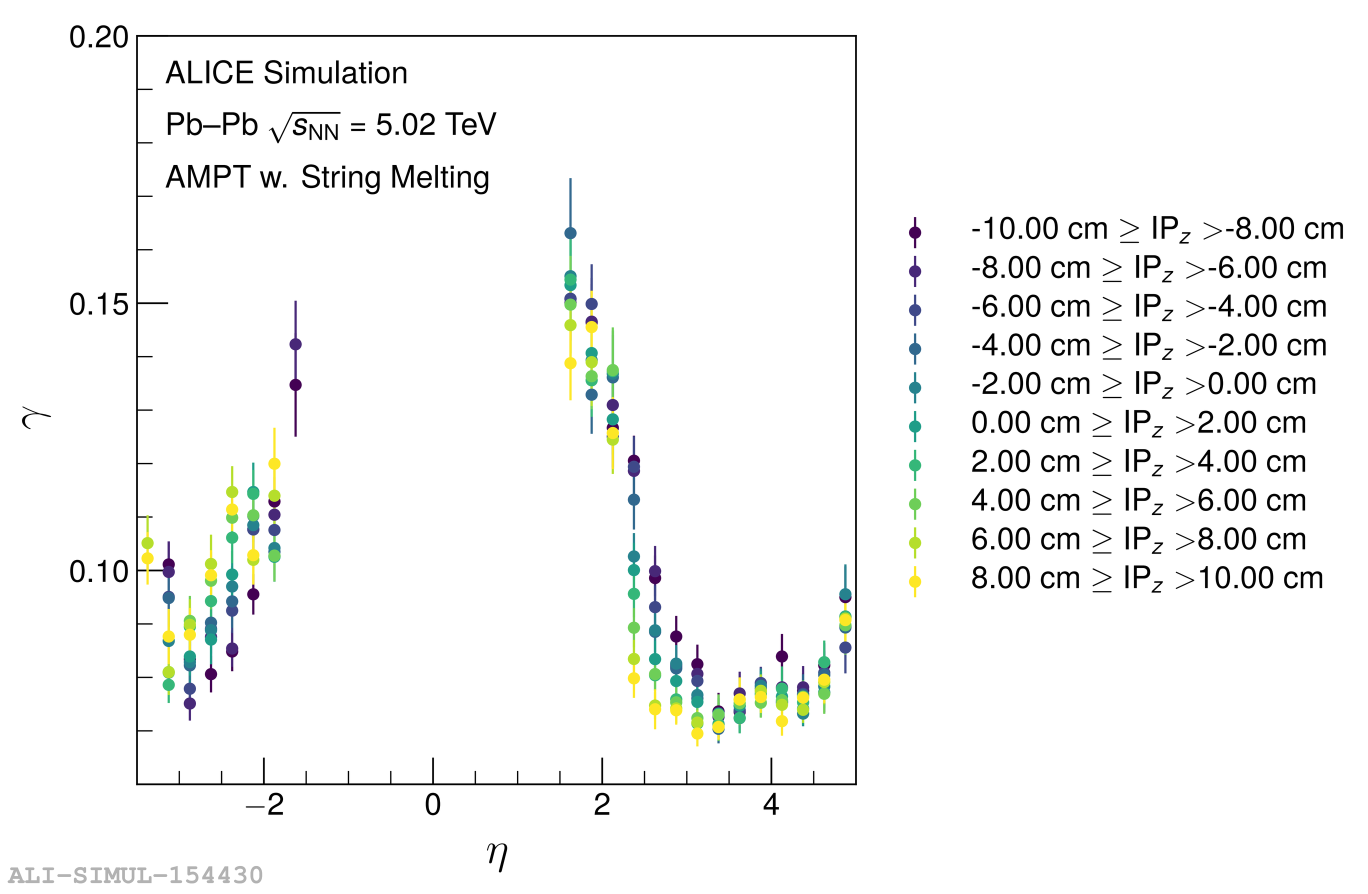

Figure: 4. The width γ from the fits.

$$\begin{aligned}\langle\langle v_n' v_n \rangle\rangle^{measured} &= \mathcal{F}\{f(\varphi) \circ P_\Delta(\Delta\varphi)\} \\ &= \mathcal{F}\{f(\varphi)\} \cdot \mathcal{F}\{P_\Delta(\Delta\varphi)\} \\ &= e^{-\gamma|n|} \cdot \langle\langle v_n' v_n \rangle\rangle^{primary}\end{aligned}$$

(v_n' = differential flow, v_n = reference flow)

Invert to find the corrected v_n,

$$\langle\langle v_n' v_n \rangle\rangle^{primary} = e^{\gamma|n|} \cdot \langle\langle v_n' v_n \rangle\rangle^{measured}$$

Results

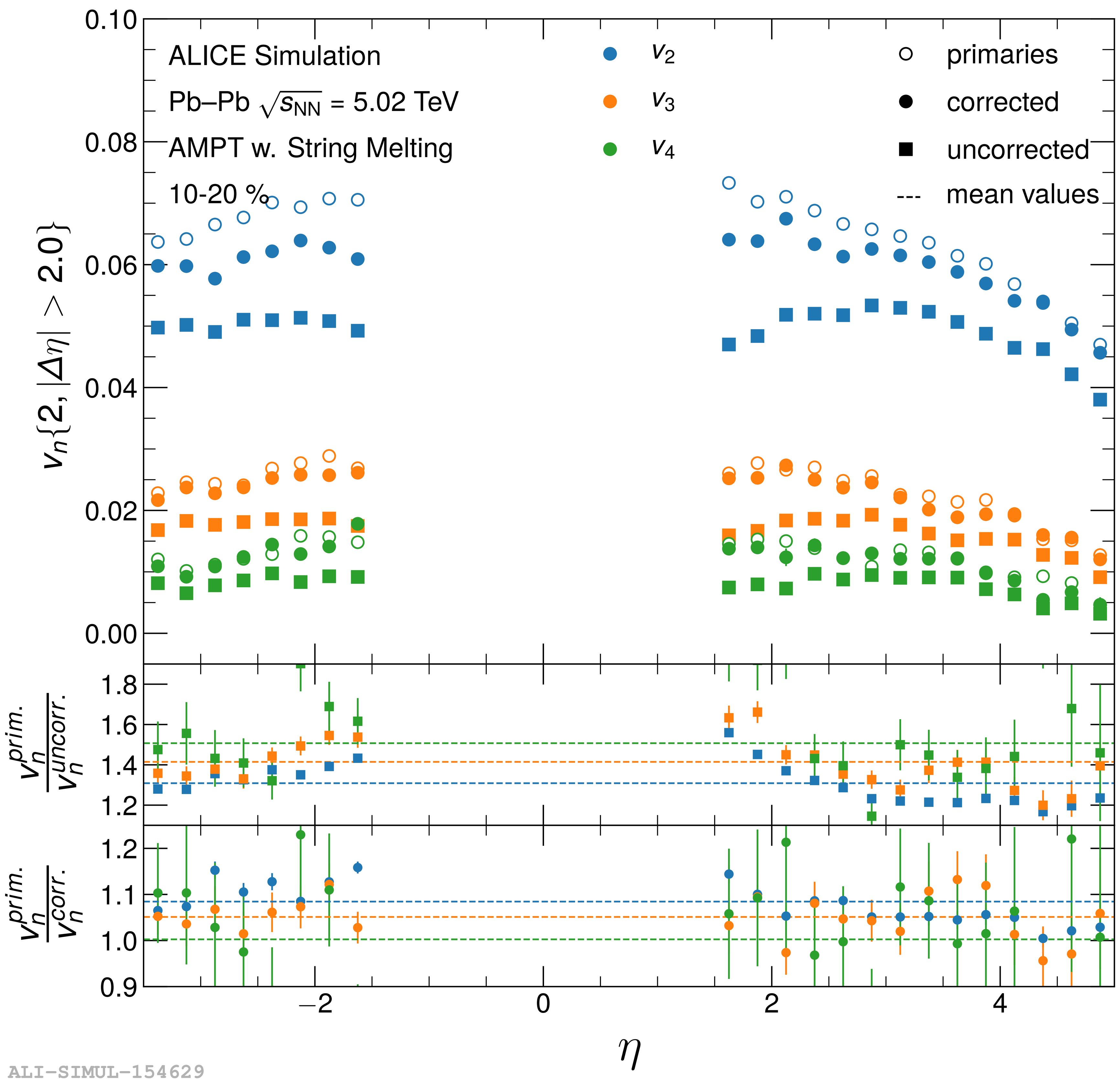

Figure: 5. Measurements of v_n with and without applying correction, and the true signal of v_n by selecting only primary particles from minimum bias collisions. Dashed lines: Weighted averages of ratios.

- Secondary particles from material decrease signal of flow

Conclusion

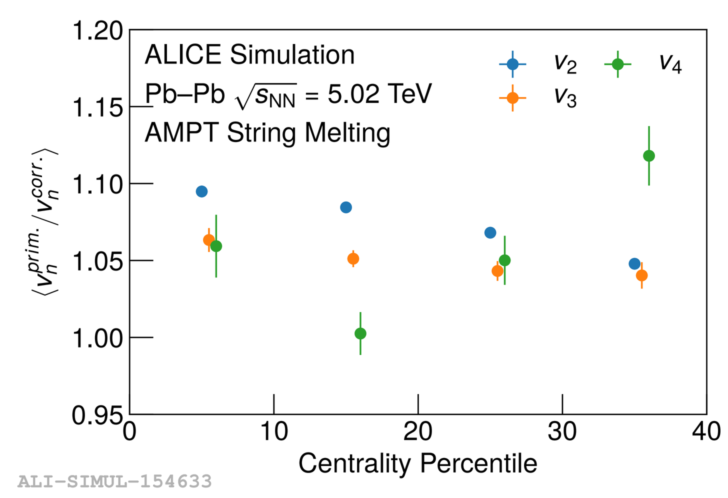

Figure: 6. The uncertainty from using the correction, obtained from weighted averages of $v_n^{prim}/v_n^{corrected}$

- Correction independent of
  - Flow model
  - Centrality
  - Center-of-mass energy
- **Universal correction for secondary smearing of particles**
- Analysis of collision data is ongoing

References

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Poster, Quark Matter 2017.