Probing the underlying PDF of $v_2(p_{\mathrm{T}})$

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Underlying PDF of v_2

Measurements of flow coefficient $v_2\{m\}$ using multiparticle cumulants shed light on the underlying probability density function (PDF) of v_2. In particular, we can test the following:

- If $v_2\{m\}$ is driven by the initial state eccentricity (ε_2), then
$$\frac{v_2\{4\}(p_{\mathrm{T}})}{v_2\{6,8\}(p_{\mathrm{T}})} = \text{const}$$
independent of p_{T}.
- If the underlying probability density function (PDF) of v_2 is given by Bessel-Gaussian distribution, then $v_2\{4\} = v_2\{6,8\}$.

In order to probe the shape of the underlying v_2 PDF we calculate the skewness (γ_1) and kurtosis (γ_2) of the distribution [1]:

$$\gamma_1 = -6\sqrt{2}v_2\{4\}^2\frac{v_2\{4\}-v_2\{6\}}{(v_2\{2\}^2-v_2\{4\}^2)^{\frac{3}{2}}}$$

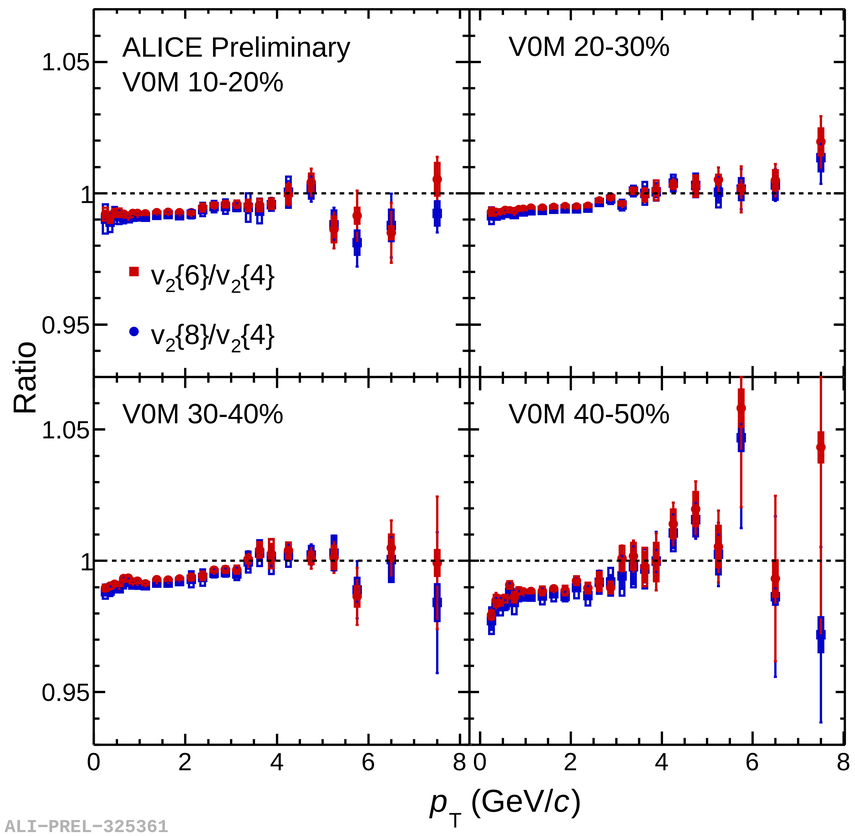
$$\gamma_2 = -\frac{3v_2\{4\}^4-12v_2\{6\}^4+11v_2\{8\}^4}{2(v_2\{2\}^2-v_2\{4\}^2)^2}$$

Previous studies [2] have reported similar measurements for the integrated flow, but now for the first times we can study the underlying PDF as a function of centrality and p_{T}.

[1] Phys. Rev. C 95, 014913

[2] JHEP 1807, 103 (2018)

Results and Discussion



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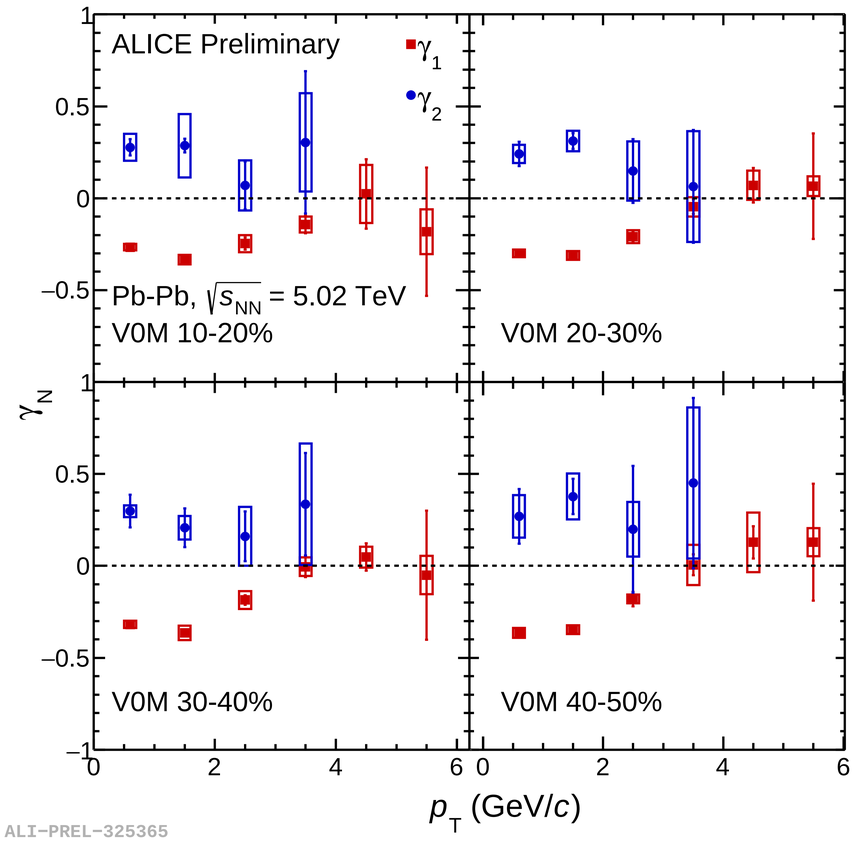
Ratios of v_2:

- $v_2\{6,8\}/v_2\{4\} \neq 1$, difference of order of a percent
  → v_2 PDF *not* described by Bessel-Gaussian distribution
- Non-trivial evolution of ratio with p_{T} and centrality
  → v_2 sensitive to medium transport parameters?
  → might point to a needed refinement of the traditional (linear) relation between v_2 and ε_2



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Skewness and kurtosis:

- Skewness $\gamma_1 \sim -0.3$ at low p_{T}, similar to hydro predictions [2]
- Kurtosis γ_2 small, positive at low p_{T}, tails larger than Gaussian distribution
- Higher p_{T} ($\gtrsim 3\,\mathrm{GeV}/c$): γ_1 and γ_2 consistent with 0, v_2 PDF approaching normal distribution

Measurements of p_{T}-differential v_2 using multiparticle cumulants provide insight into the underlying probability density function. In particular, it suggests that v_2 is sensitive to medium transport properties, its PDF has a large left-sided tail at low p_{T} and approaches normal distribution at $p_{\mathrm{T}} \sim 3\,\mathrm{GeV}/c$.