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Probing hydrodynamics in PbPb collisions at $\sqrt{s_{\mathrm{NN}}} =$ 5.02 TeV using higher-order cumulants, $v_2\{2k\}$ $(k = 1, ..., 5)$

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The elliptic flow harmonic $v_2\{2k\}$ is determined using Q-cumulants of different orders, with $k = 1, ..., 5$, for 5.02 TeV PbPb collisions. The results were obtained using data from the CMS experiment at the LHC. The $v_2\{2k\}$ values show an ordering, with $v_2\{2\} > v_2\{4\} >\approx v_2\{6\} >\approx v_2\{8\} >\approx v_2\{10\}$. The hydrodynamics behavior of the medium can be probed with high precision using the higher order moments of the cumulant expansion. It is found that both hydrodynamics probes $\frac{v_2\{6\}-v_2\{8\}}{v_2\{4\}-v_2\{6\}}$ and $\frac{v_2\{8\}-v_2\{10\}}{v_2\{6\}-v_2\{8\}}$ are centrality dependent. This dependence is explained by introducing previously ignored higher order moments in the Taylor expansion of the corresponding generating function of the cumulants. The higher order moments, skewness, kurtosis and the new 5th moment are expressed through the $v_2\{2k\}$ $(k = 1, ..., 5)$ harmonics and measured as a function of centrality. The results bring new precision to probes sensitive to initial-state fluctuations.

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