Available online at www.sciencedirect.com

ScienceDirect

Nuclear Physics A 00 (2012) 1–3

NUCLEAR PHYSICS A

www.elsevier.com/locate/nuclphysa

Measurement of Fourier components of two-particle correlations in PbPb collisions at $\sqrt{s} = 2.76$ TeV with CMS

Rylan Conway for the CMS Collaboration

Department of Physics, University of California, 1 Shields Ave, Davis, CA 95616 U.S.A.

Abstract

These proceedings presents the results from azimuthal angle correlations of charged hadrons measured in $\sqrt{s_{NN}} =$ 2.76 TeV PbPb collisions by the CMS experiment at the LHC. Two-particle correlation functions are shown in 2D for multiple centralities. The factorization assumption of the anisotropy parameters from two-particle correlations is directly tested for various centralities and p_T^{trig} ranges. Higher order azimuthal anisotropy coefficients are also extracted from two-particle correlations and presented as a function of N_{part} for three separate p_T^{trig} ranges.

1. Introduction

In non-central heavy ion collisions, the interaction region is spatially anisotropic, often characterized as an "almond shape". This anisotropy in the initial collision geometry leads to a final-state momentum azimuthal anisotropy with respect to the participant plane. This anisotropy can be characterized with a Fourier expansion of the azimuthal distribution from two-particle correlation functions. The resulting Fourier coefficients are known as anisotropy or flow parameters and provide information about the collective behavior of the medium.

2. Two-Particle Correlations and Factorization

Dihadron correlations are a tool used to investigate the flow properties of the QGP. The associated yield, shown in Fig. 1, shows two-particle correlations plotted as a function of $\Delta\eta$ and $\Delta\phi$ between the two particles for twelve different centrality ranges [1]. The correlated particles are each chosen such that a "trigger" particle in a given p_T^{trig} range is paired with all of the "associated" particles in a given event that are in a specified p_T^{assoc} range. These were measured using the CMS detector, a detailed description of the detector can be found here [2].

By looking at the long-range region of the associated yield, $2 < |\Delta\eta| < 4$, and projecting onto the $\Delta\phi$ axis, we can Fourier-expand the 1-D associated yield and extract the coefficients, $V_{n\Delta}(p_T^{trig}, p_T^{assoc})$. It is assumed that the Fourier coefficients from dihadron correlations can be factored into the product of the single-particle azimuthal anisotropy harmonics: $V_{n\Delta}(p_T^{trig}, p_T^{assoc}) = v_n(p_T^{trig}) \times v_n(p_T^{assoc})$. This relationship can then be used to extract v_2 and the higher-order harmonics.

3. Results

To experimentally test the validity of the factorization assumption the ratio of the two-particle azimuthal anisotropy harmonic, $V_{n\Delta}$, to the product of the corresponding single-particle azimuthal anisotropy harmonics is investigated.

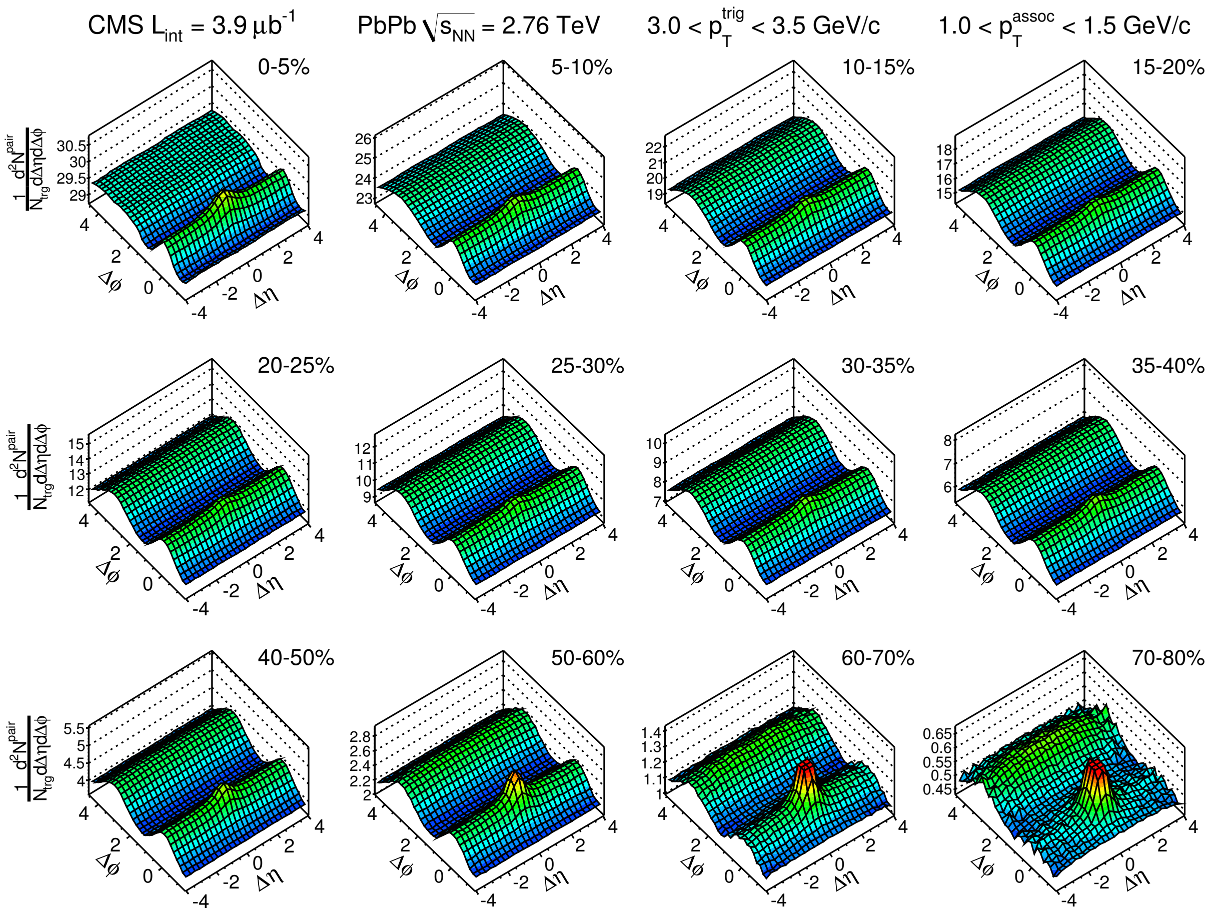

Figure 1: Two-particle correlation functions shown in 2D as a function of $\Delta\eta$ and $\Delta\phi$ for twelve different centrality classes (going from most central in the top left to most peripheral in the bottom right) with $3.0 < p_T^{trig} < 3.5$ GeV/c and $1.0 < p_T^{assoc} < 1.5$ GeV/c.

Therefore, if the ratio is one than the assumption is valid, this is shown for v_2 in Fig. 2 where the red points are for particles with $2 < |\Delta\eta| < 4$ and the open white circles are for mid-rapidity particles, $0 < |\Delta\eta| < 1$. The left, middle, and right columns show the results for 0-5%, 15-50%, and 35-40% central collisions, respectively. The different rows represent different p_T^{assoc} ranges, increasing from top to bottom. The factorization assumption does not seem to hold for central collisions but appears to be valid for non-central collisions at low p_T^{assoc}.

The higher-order azimuthal anisotropy harmonics can also be derived assuming that the factorization relation is valid. In Fig. 4 the results for v_2 (black circles), v_3 (red triangles), v_4 (blue squares), and v_5 (green stars) are shown as a function of N_{part} for $2 < |\Delta\eta| < 4$ and $1 < p_T^{assoc} < 3$ GeV/c in three different p_T^{trig} bins. The higher order harmonics, v_3 - v_5, show little centrality dependence while v_2 shows a very strong dependence on centrality.

4. Conclusions

In summary, dihadron correlations in PbPb collisions at $\sqrt{s_{NN}} = 2.76$ TeV with the CMS detector were measured for a variety of centralities and p_T^{trig} and p_T^{assoc} combinations and used to study the azimuthal anisotropies of the interaction region. The factorization assumption of the two-particle azimuthal anisotropy coefficients was tested and shown to be valid for non-central collisions at low p_T^{assoc} for $2 < |\Delta\eta| < 4$. The coefficients were also shown as a function of N_{part}. There is a strong centrality dependence of v_2 but not for the higher-order coefficients.

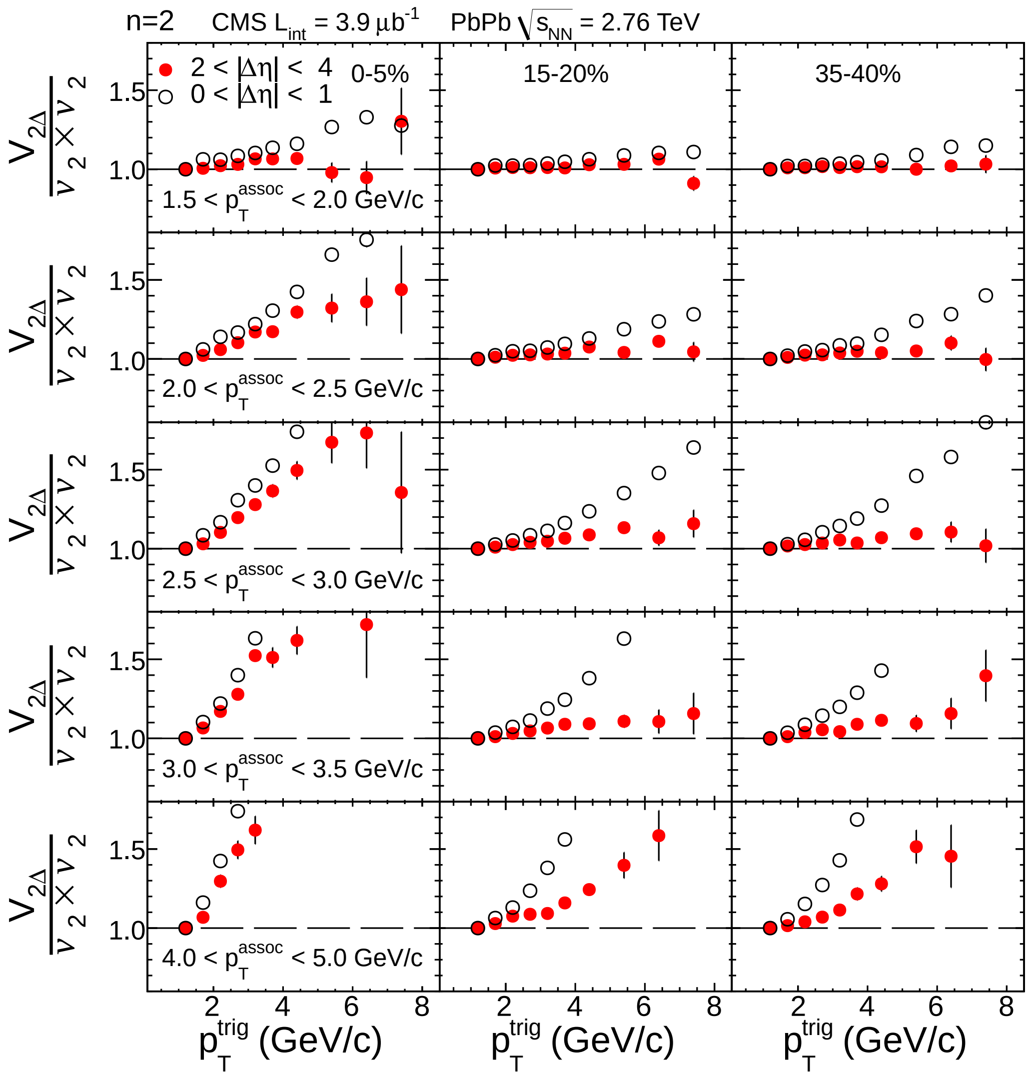

Figure 2: The test of the factorization assumption. The second order Fourier coefficient from two-particle correlation functions divided by the Fourier coefficients derived from single-particle correlations. The left row is for the 0-5% most central collisions, the middle row shows 15-20% centrality, and the right column shows 35-40% centrality. The different rows show different p_T^{trig} ranges. The red dots are for $2 < |\Delta\eta| < 4$ and the open white dots are for $0 < |\Delta\eta| < 1$.

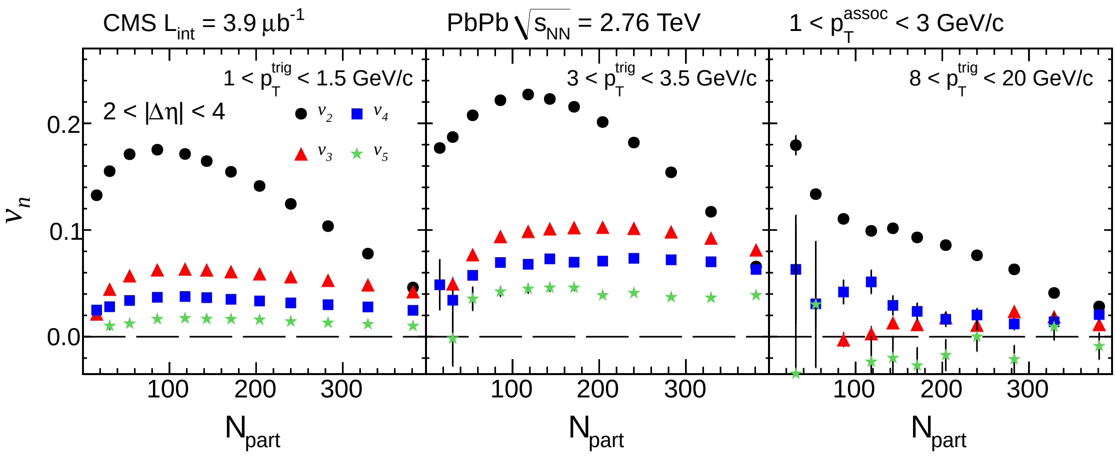

Figure 3: The single-particle anisotropy coefficients as a function of N_{part} for $2 < |\Delta\eta| < 4$. The left panel is for $1 < p_t^{trig} < 1.5$ GeV/c, the middle panel is for $3 < p_T^{trig} < 3.5$ GeV/c, and the right panel is for $8 < p_T^{trig} < 20$ GeV/c. The black points show v_2, the red points show v_3, the blue points show v_4, and the green points show v_5

References

[1] CMS Collaboration, arXiv:submit/0398170 [nucl-ex] 16 Jan 2012.
[2] CMS Collaboration, 2008 JINST 3 S08004.