

## **Paper (1)**

### **Title:**

**Evidence for Collective Multiparticle Correlations in p-Pb Collisions**

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*Authors:* CMS Collaboration (M.A. Mahmoud et. al)

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### **Abstract:**

The second-order azimuthal anisotropy Fourier harmonics,  $v_2$ , are obtained in p-Pb and PbPb collisions over a wide pseudorapidity ( $\eta$ ) range based on correlations among six or more charged particles. The p-Pb data, corresponding to an integrated luminosity of  $35 \text{ nb}^{-1}$ , were collected during the 2013 LHC p-Pb run at a nucleon-nucleon center-of-mass energy of 5.02 TeV by the CMS experiment. A sample of semiperipheral PbPb collision data at  $\sqrt{s_{NN}} = 2.76 \text{ TeV}$ , corresponding to an integrated luminosity of  $2.5 \mu\text{b}^{-1}$  and covering a similar range of particle multiplicities as the p-Pb data, is also analyzed for comparison. The six- and eight-particle cumulant and the Lee-Yang zeros methods are used to extract the  $v_2$  coefficients, extending previous studies of two- and four-particle correlations. For both the p-Pb and PbPb systems, the  $v_2$  values obtained with correlations among more than four particles are consistent with previously published four-particle results. These data support the interpretation of a collective origin for the previously observed long-range (large  $\Delta\eta$ ) correlations in both systems. The ratios of  $v_2$  values corresponding to correlations including different numbers of particles are compared to theoretical predictions that assume a hydrodynamic behavior of a p-Pb system dominated by fluctuations in the positions of participant nucleons. These results provide new insights into the multiparticle dynamics of collision systems with a very small overlapping region.