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Probing QCD Collectivity over the Widest Rapidity Gap in Photonuclear Collisions at CMS

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Understanding collectivity in small systems like proton-proton and proton-ion collisions remains a key challenge in heavy-ion physics. Recent LHC studies show signs of collectivity in high-multiplicity photonuclear collisions, where a quasi-real photon from one nucleus interacts with the other nucleus. In this talk, we present CMS measurements of two- and multi-particle correlations from photonuclear collisions using PbPb data at $\sqrt{s_{NN}} = 5.36$ TeV collected during the LHC Run 3. By leveraging the full detector acceptance, we explore wide pseudorapidity gaps up to 7–8 units, correlating particles in the central tracker with the Hadron Forward (HF) detector, which significantly reduces non-collective contributions and enhances the search for long-range near-side ridge effects. Elliptic and triangular azimuthal anisotropies are extracted as functions of particle transverse momentum and event multiplicity. Furthermore, the first measurements of four-particle azimuthal correlations in high-multiplicity events are presented, offering a direct probe of collective effects. These results provide key insights into collectivity in photonuclear collisions and shed light on the potential conditions for QGP formation in small systems.

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