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Probing the properties of the quark–gluon plasma through radial and anisotropic flow correlations across collision systems with CMS

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The study of collective phenomena in high-energy nuclear collisions provides crucial insights into the formation and evolution of the quark–gluon plasma (QGP). The transverse momentum–dependent isotropic flow observable, $v_0(p_T)$, probes radial flow fluctuations and their evolution from small to large systems, providing sensitivity to the medium's transport properties. Using data recorded with the CMS experiment at the LHC, the evolution of radial flow and its dependence on system size is measured and compared for the first time in pp, pPb, newly measured oxygen–oxygen (OO) and neon–neon (NeNe), and PbPb systems. Complementary measurements of the covariance between anisotropic flow coefficients and mean transverse momentum, $\mathrm{cov}(v_n, [p_T])$, quantify correlations between geometric anisotropy and overall expansion strength. Also, elliptic (v_2) and triangular (v_3) flow harmonics are measured to characterize the anisotropic response to nuclear geometry in OO and NeNe systems. These results provide a unified picture of the QGP evolution across different collision systems and offer new constraints on initial-state fluctuations and nuclear deformation.

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