



## Search for elliptic azimuthal anisotropies in photon-proton and pomeron-Pb interactions with ultraperipheral pPb collisions with the CMS experiment

*Tuesday 14 June 2022 17:10 (1 minute)*

For several years there has been a strong interest in measuring collective effects in small systems such as proton-proton (pp) and proton-lead (pPb). Such measurements give new insights into the nature of QCD and the meaning of collectivity. In recent years ALEPH, ATLAS, and ZEUS collaborations have extended these studies to electromagnetic interactions such as electron-positron (ee), photon-lead ( $\gamma$ Pb), and electron-proton (ep) systems, respectively. No evidence of collectivity as in pp or pPb (for the same degree of collectivity) was found, placing a bound on the multiplicity range of long-range collectivity. The CMS Collaboration further extends the measurements into photon-proton ( $\gamma$ p) and pomeron-lead (PPb) interactions using ultraperipheral pPb collisions at 8.16 TeV. Such interactions provide unique initial conditions with event multiplicity lower than in pp and pPb systems but comparable with ee and ep systems, whereas, and in contrast to the other systems, PPb is a pure QCD interaction. This talk will summarize the first measurements of long-range particle correlations in  $\gamma$ p and PPb systems.

### Present via

Online

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**Session Classification:** Poster

**Track Classification:** Bulk matter phenomena, QCD phase diagram, and Critical point