

Evidence for light-by-light scattering and limits on axion-like-particles from ultraperipheral PbPb collisions at 5 TeV

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A measurement of light-by-light scattering, $\gamma\gamma \rightarrow \gamma\gamma$, in ultraperipheral PbPb collisions at a centre-of-mass energy per nucleon pair of 5.02 TeV is reported. The analysis is conducted using a data sample corresponding to an integrated luminosity of $390 \mu\text{b}^{-1}$ recorded by the CMS experiment at the LHC. Light-by-light scattering processes are selected in events with two photons exclusively produced, each with transverse energy $E_T > 2$ GeV, pseudorapidity $|\eta| < 2.4$, diphoton invariant mass $m(\text{gamgam}) > 5$ GeV, diphoton transverse momentum $p_T < 1$ GeV, and diphoton acoplanarity below 0.01. After all selection criteria are applied, 14 events are observed, compared to expectations of 11.1 ± 1.1 (th) events for the signal and 3.8 ± 1.3 (stat) for the background processes. The significance of the light-by-light signal against the background-only hypothesis is 4.1 standard deviations. The measured fiducial light-by-light scattering cross section, $\sigma_{\text{fid}}(\gamma\gamma \rightarrow \gamma\gamma) = 122 \pm 46$ (stat) ± 29 (syst) ± 4 (th) is consistent with the standard model prediction. The present results allow also to place new competitive limits, reported for the first time, on the production of pseudoscalar axion-like particles, produced in the process $\gamma\gamma \rightarrow a \rightarrow \gamma\gamma$, over the mass range $m_a = 5\text{--}50$ GeV.

Summary

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