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Light-by-light scattering at low diphoton energies from ultraperipheral heavy-ion collisions at the LHC

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We present a study of photon-photon scattering in the mass range $W_{\gamma\gamma} < 5$ GeV. We extend earlier calculations of this cross section for $W_{\gamma\gamma} > 5$ GeV into the low mass range where photoproduction of the pseudoscalar resonances $\eta, \eta'(958)$ contributes to two-photon final states. We present the elementary photon-photon cross section as a function of diphoton mass $M_{\gamma\gamma}$ arising from lepton and quark loop diagrams, and the visible cross section obtained with the gamma-gamma decay branching fractions of the resonances η, $\eta'(958)$, $\eta_C(2S)$, $\chi_{c0}(1P)$. We derive the corresponding cross sections in ultraperipheral Pb-Pb collisions at $\sqrt{s_{NN}} = 5.02$ TeV by folding the elementary cross section with the heavy-ion photon fluxes. We consider the dominating background of the two-photon final
state which arises from gamma decays of photoproduced π^0-pairs. Such π^0-pairs contribute to the background when only two of the four decay photons are within the experimental acceptance, while the other two photons escape undetected. We show how to reduce this background by applying cuts on asymmetries of transverse momenta of the two photons and indicate how the background can be further suppressed using a multivariate sideband analysis. We present the cross section for the signal and the background at midrapidity $|\eta| < 0.9$, and in the forward rapidity range $2.0 < \eta < 4.5$.

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