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Impact of inelastic corrections on $\gamma\gamma \to \gamma\gamma$ scattering from UPC at the LHC

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The current state of art estimations lead to cross sections
for $AA \to \gamma\gamma AA$ which are somewhat
smaller than the measured ones by the ATLAS and CMS Collaborations.
We calculate inelastic contribution to $\gamma\gamma \to \gamma\gamma$
scattering process in $AA \to \gamma\gamma XY$ where $X, Y = A, A'$.
We include processes of coupling of photons to individual nucleons
(protons and neutrons) in addition to coherent coupling to the
whole nuclei (call standard approach here).
Both elastic (nucleon in the ground state) and inelastic
(nucleon in an excited state) in the couplings of photons to nucleons
are taken into account. The inelastic nucleon fluxes are calculated
using CT18qed photon PDFs. The inelastic photon fluxes are
shown and compared to standard photon fluxes in the nucleus.
These new mechanisms are related to extra emissions that are rather
difficult to identify at the LHC.
The considered here new contributions can be mistakenly interpreted
as enhanced $\gamma\gamma \to \gamma\gamma$ scattering
compared to the Standard Model result.
We find corrections to the traditional (no nuclear excitation)
contribution $AA \to AA\gamma\gamma$. We find the inelastic
contributions to be 10-15 \% of the standard one.
In addition, we show the ratio of the inelastic corrections to
the standard contribution as a function of diphoton invariant mass
and photon rapidity difference. We find the maximal effect of the inelastic
corrections at $M_{\gamma\gamma} \sim 14$ GeV for the ATLAS
rapidity and transverse momentum acceptance.
Furthermore, the inelastic contribution increases gradually with photon
rapidity difference.

Author: SZCZUREK, Antoni

Presenter: SZCZUREK, Antoni

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