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## $\gamma\gamma \rightarrow \gamma\gamma$ scattering in ultrarelativistic UPC

Friday, July 7, 2017 10:45 AM (15 minutes)

We will report on our results for light-by-light scattering in ultraperipheral Pb-Pb collisions at the LHC.

We calculate cross section for the elementary  $\gamma\gamma \rightarrow \gamma\gamma$  subprocess taking into account the following contributions:

- (a) box mechanisms with leptons and quarks in the loops,
- (b) VDM-Regge mechanism (fluctuation of both photons to vector mesons and their interaction) and
- (c) two-gluon exchange.

Our nuclear calculations are based on equivalent photon approximation in the impact parameter space. We use realistic charge form factor of nuclei which is a Fourier transform of the charge distribution in nuclei.

Our estimate has shown that ultraperipheral Pb-Pb collisions can be measured at the LHC. This opened a possibility to study the  $\gamma\gamma \rightarrow \gamma\gamma$  scattering at the LHC.

Our rather optimistic predictions became a motivation for experimental groups to perform corresponding experimental studies.

Very recently, the ATLAS Collaboration observed 13 events for light-by-light scattering in ultraperipheral Pb-Pb collisions.

They obtained the cross section of  $70 \pm 20(\text{stat.}) \pm 17(\text{syst.})$  nb.

Simultaneously, our Standard Model predictions gave  $49 \pm 10$  nb.

Our theoretical calculations were a source of ATLAS Monte Carlo simulation.

The ATLAS measurement is a first experimental observation of the  $\gamma\gamma \rightarrow \gamma\gamma$  mechanism.

In the talk, we shall present many differential distributions.

We shall discuss a possibility of a separation and identification of different components (three subprocesses mentioned above). We shall present a similar analysis for the  $pp \rightarrow pp\gamma\gamma$  reaction.

This talk will be based mainly on our analyses which were presented in Ref. [1] and [2].

[1] M. Kłusek-Gawenda, P. Lebiedowicz and A. Szczurek, Phys. Rev. C93 (2016) 044907,

[2] M. Kłusek-Gawenda, W. Schäfer and A. Szczurek, Phys. Lett. B761 (2016) 399.

[3] The ATLAS Collaboration, ATLAS-CONF-2016-111 (2016).

### Experimental Collaboration

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