

The future of experimental measurements of light-by-light scattering

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Light-by-light scattering is a relatively new area in experimental physics. Since its first observation in 2017 by the ATLAS collaboration, which was reported in Nature [1], only three studies have been published with new results [2-4], all within a similar kinematic range. Our recent research [5] shows that studying two-photon measurements in regions with lower transverse momentum ($p_{t,\gamma}$) and invariant mass ($M_{\gamma\gamma}$) allows us to observe not only the main contribution of photon scattering, known as fermionic loops but also weaker mechanisms like the VDM-Regge.

In addition, examining two-photon measurements in low-mass regions is crucial for researching light meson resonances to $\gamma\gamma \rightarrow \gamma\gamma$ scattering. We have begun investigating the interference between different contributions. For future experiments with the ALICE FoCal detector [6] and ALICE 3 [7], we have calculated background estimates and explored possibilities to minimize their impact.

Our predictions suggest that these new mechanisms are challenging both theoretically and their experimental verification is difficult. However, the planned upgrades to existing detectors and the development of new ones present a unique opportunity to verify this complex picture.

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[3] Aad, G. et al. (ATLAS Coll.), Phys. Rev. Lett., 123, 052001, 2019.

[4] G. Aad et al. (ATLAS Coll.), JHEP, 03:243, 2021. [Erratum: JHEP 11, 050 (2021)].

[5] P. Jucha, M. Klusek-Gawenda, A. Szczurek, Physical Review D 109, 014004, 2024.

[6] C. Loizides, W. Riegler et al. (ALICE Coll.), CERN Document Server, LHCC-I-036, Jun 2020.

[7] L. Musa, W. Riegler et al. (ALICE Coll.), CERN Document Server, LHCC-I-036, Mar 2022.

Authors: Prof. SZCZUREK, Antoni (IFJ PAS); KLUSEK-GAWENDA, Mariola (IFJ PAS); JUCHA, Pawel (Institute of Nuclear Physics Polish Academy of Sciences)

Presenter: JUCHA, Pawel (Institute of Nuclear Physics Polish Academy of Sciences)