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Light-by-light scattering with intact protons at the LHC: from Standard Model to New Physics

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The scheduled installation of forward proton detectors at the LHC nearby the CMS and ATLAS experiments will provide a – somewhat surprising – opportunity to measure the light-by-light scattering with unprecedented precision by taking advantage of the coherent photon flux emitted by the protons. The detection of the intact protons allows to reconstruct the full kinematic of the event which is very powerful to reject background. It is then possible to probe anomalous photon quartic couplings (4γ) with an excellent accuracy whereas very few constraints on those couplings exist at the moment. A large variety of extra-dimension models predicts a significant rise of the 4γ coupling through new productions at tree level and any new electrically charged particle contributes to it through loops. The full 4γ amplitudes generated by any electrically charged particles of spins $1/2$ and 1, including the Standard Model processes are implemented in the Forward Physics Monte Carlo generator. First, a possible measurement of the Standard Model production is examined and then model-independent bounds on massive charged particles, only parametrized by the spin, mass and their "effective charge" $Q_{\rm eff}$ are derived. We also discuss the sensitivities to neutral particles such as a strongly-interacting heavy dilaton and warped Kaluza-Klein gravitons using an effective field theory approach and claim they could be discovered for masses in the multi-TeV range.

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