Experimental study of ultraperipheral interactions with leptons in the final state using the ATLAS detector at the LHC

ATLAS is one of the four major experiments at the Large Hadron Collider (LHC) at CERN. It is a general-purpose particle physics experiment run by an international collaboration and is designed to exploit the full discovery potential and the huge range of physics opportunities that the LHC provides. ATLAS' scientific exploration uses precision measurement to push the frontiers of knowledge by seeking answers to fundamental questions such as: What are the basic building blocks of matter? What are the fundamental forces of nature? ATLAS physicists test the predictions of the Standard Model, which encapsulates our current understanding of what the building blocks of matter are and how they interact. These studies can lead to ground-breaking discoveries, such as that of the Higgs boson, physics beyond the Standard Model and the development of new theories to better describe our universe.

Collisions of hadrons in the LHC can provide a uniquely clean environment to test the Standard Model predictions. For example, bunches of lead ions that are accelerated to very high energy are surrounded by an enormous flux of photons. Indeed, the coherent action from the large number of 82 protons in a lead atom with all the electrons stripped off (as is the case for the lead ions in the LHC) give rise to an electromagnetic field of up to 10^{25} Volt per metre. When two hadrons pass close by each other at the centre of the ATLAS detector, but at a distance greater than the sum of their radii, those photons can interact and produce new particles. Hence, the LHC can be effectively transformed into a high-energy photon collider.