Analysis of the ultraperipheral events in heavy–ion collisions in the CMS experiment in the Large Hadron Collider at CERN

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CERN is European research organization located at suburb of Geneva on the Franco–Swiss border. It operates the largest particle physics laboratory in the world. The main experiment is the Large Hadron Collider (LHC) which is the largest machine on the World. It is located in 27 km long underground tunnel. It accelerates particles and then they are collided at four interaction points. Around those points large detectors collect the data measuring the products of those interactions. One of those detectors is Compact Muon Solenoid (CMS).

In this project I will analyze the data that will be collected during the Run–2 of the LHC (2015 – 2018) by the CMS experiment. The events I will focus on in this analysis are called ultraperipheral. They occurs when particles do not collide, they fly very close to each other and, as they are charged particles, they exchange photon – the carrier of the electromagnetic interaction. This photon has very high energy and thus can penetrate the nucleus and interact with its constituents – quarks and gluons (partons). The measurement of the particles created in this processes (called photoproduction), allows for the study of interaction between partons; strong interactions described by Quantum Chromodynamisc. These is the strongest from four fundamental interactions. They are responsible for building up protons and neutrons – the main components of the visible Universe.

The aim of this project is to obtain the cross-section for the Upsilon production in the ultraperipheral events during heavy ions collisions and to calculate the constrains for the nuclear gluon distribution function in new kinematic region. This will deliver more precise description of the initial state of relativistic nuclei, what will give the fundaments for future studies of strongly interacting matter.

The results obtained in this project will broaden our understanding of the quark-gluon plasma, which is a state in which the Universe existed after the Big Bang.

The results of this project will be published in renowned international journals, and will be presented on international conferences dedicated to this subject.