Master 2 training - 5 months (February-June 2018)

Measurement of Z boson production in p–Pb collisions at $\sqrt{s_{\rm NN}} = 8.16$ TeV with ALICE

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The aim of ultra-relativistic heavy-ion collisions is to pin down the nuclear equation of state by studying the properties of nuclear matter under extreme conditions of temperature and pressure. The ultimate goal is to study the deconfinement of the hadron constituents in the so-called Quark-Gluon Plasma (QGP). This phase of matter is believed to have constituted the universe a few micro-seconds after the Big-Bang. A Large Ion Collider Experiment (ALICE) is one of four major experiments installed at the Large Hadron Collider (LHC) at CERN (European Organization for Nuclear Research). It is mainly dedicated to the study of the matter produced in ultra-relativistic heavy-ion collisions.

Measurements in proton-nucleus collisions can serve as references for nucleus-nucleus collisions and be used as inputs for the determination of nuclear parton distribution functions (nPDF). Indeed, PDF are expected to be modified for nucleons inside a nucleus compared to those of free nucleons. nPDFs for high energy scale Q^2 and small x (x being the momentum fraction of the nucleon carried by the parton) have either no or only weak direct constraints from data.

Electroweak bosons and their lepton decay products are unaffected by the hot and dense strongly-interacting matter formed in ultra-relativistic heavy-ion collisions and offer a unique opportunity to study the nPDF. In addition, the W and Z boson production occurs in hard scattering processes at the initial stage of the collision, and it is expected to scale with the number of binary nucleon-nucleon collisions.

This research training aims first to learn the strategy to reconstruct an invariant mass distribution of Z boson decaying into two muons in the ALICE Muon Spectrometer. Signal extraction and its systematic uncertainty will complete the first part of the training. In a second step, with a realistic simulation of the detector, the objective will be to go through all analysis steps in order to be able to estimate a preliminary Z production cross section.

The work will be developed by using C++ programmable language under the ALICE software (AliRoot). A good knowledge of C ++ is required and knowledge of Root is an advantage (https://root.cern.ch/).