Description for general public

The Standard Model of particle physics, formulated in sixties, is a collection of theories that embodies all of our current understanding of fundamental particles and forces. According to this theory, which is supported by a great deal of experimental evidence, one can predict various observables to a very high precision. A great achievement was accomplished in 2012 - an observation of the Higgs boson at the Large Hadron Collider at CERN, being the last missing particle predicted by the Standard Model of particle physics. Yet, for all its predictive power, the Standard Model is not perfect - some of the observed phenomena such as dark matter and the absence of antimatter in the Universe remain unexplained, and cannot be accounted for in the model. In the above drew perspective, more universal theory is now searched for. A measured Higgs boson mass as well as direct searches for the phenomena beyond Standard Model performed at LHC suggest that new particles beyond the Standard Model may be observed at much higher energy scale than presently assumed. In this way, in searching for New Physics, low-energy high-precision measurements are complementary to the LHC high-energy frontier. The importance of measurements alternative to the searches at LHC is now constantly growing, which may provide crucial hints to create new theoretical models - extensions of the Standard Model.

A good example of the pioneering experiments designed to search for New Physics phenomena in sectors beyond searches at LHC is the MUonE experiment at the CERN SPS, planned to be operating in 2023-2026. Its research program is related to a precise measurement of the muon’s anomalous magnetic moment. A remarkable discrepancy of measured value of this observable with respect to the Standard Model predictions can be observed. In order to ultimately confirm this premise, a high accuracy measurement is needed, employing an elastic muon-electron scattering process. This will allow for the precise determination of the hadronic contribution to the anomalous muon magnetic moment, representing a major source of uncertainty for the theoretical predictions. A confirmation of observed discrepancy would be a big step forward to search for New Physics beyond the Standard Model, getting a hint for the future direction of the experimental and theoretical high energy physics.

The physics program of the MUonE experiment is enriched with the search for New Physics phenomena, such as candidates for dark matter in the form of the so-called *dark photons*, the existence of which is predicted by a number of models that are an extension of the Standard Model. It seems that the above phenomena can also be successfully studied in the MUonE experiment due to the clean experimental environment and the large number of events that are planned to be collected.

The major goal of this project proposal is an active participation of the Polish MUonE group from the Institute of Nuclear Physics at Polish Academy of Sciences in all crucial stages of the MUonE experiment, starting from detector design, through data taking, and ending up with data analysis. A significant contribution will be made in development of the trigger architecture, together with a preparation of novel online event reconstruction algorithms. It will include also a participation in full detector simulation and its alignment, data taking and commissioning phases, data quality monitoring, study of the systematic effects and the contribution to development of dedicated procedures for the final data analysis.