MUSE: Two Photon Exchange in Elastic $e^{\pm}p$ and $\mu^{\pm}p$ Scattering

ABSTRACT

Over the past decade, there were significant efforts (both theoretical and experimental) to study the two photon exchange (TPE) contribution in elastic lepton-proton scattering. There are three recent experiments (VEPP-3, CLAS and OLYMPUS), which have reported on direct measurements of TPE. All three experiments measured TPE in elastic $e^{\pm}p$ scattering at low to moderate momentum transfer ($Q^2 \approx 1 \div 3$ GeV^2). The reported data indicate the presence of TPE effect.

The proposed research focuses on experimental study of the TPE contribution to elastic $e^{\pm}p$ and $\mu^{\pm}p$ scattering at a very low momentum transfer ($Q^2 < 0.1$ GeV^2). This measurement is a part of the MUon proton Scattering Experiment (MUSE). The experiment is designed to address the Proton Radius Puzzle (PRP): the discrepancy between the radius of the proton as measured with electrons, and that measured using muons.

The scattering data obtained in MUSE will allow to measure TPE contribution in elastic muon-proton scattering at first time. Comparison of the TPE contribution extracted from elastic $e^{\pm}p$ and $\mu^{\pm}p$ will test lepton universality, which is related to the ”proton radius puzzle”.