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Two-photon exchange corrections in elastic lepton-proton scattering at small momentum transfer OLEKSANDR TOMALAK, MARC VANDERHAEGHEN, Johannes Gutenberg University Mainz — In recent years, elastic electron-proton scattering experiments, with and without polarized protons, gave strikingly different results for the electric over magnetic proton form factor ratio. A mysterious discrepancy (“the proton radius puzzle”) has been observed in the measurement of the proton charge radius in muon spectroscopy experiments versus electron spectroscopy and electron scattering. Two-photon exchange (TPE) contributions are the largest source of the hadronic uncertainty in these experiments. We compare the existing models of the elastic contribution to TPE correction in lepton-proton scattering. A subtracted dispersion relation formalism for the TPE in electron-proton scattering has been developed and tested. Its relative effect on cross section is in the 1–2 % range for a low value of the momentum transfer. An alternative dispersive evaluation of the TPE correction to the hydrogen hyperfine splitting was found and applied. For the inelastic TPE contribution, the low momentum transfer expansion was studied. In addition with the elastic TPE it describes the experimental TPE fit to electron data quite well. For a forthcoming muon-proton scattering experiment (MUSE) the resulting TPE was found to be in the 0.5–1 % range, which is the planned accuracy goal.

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