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Proton charge radius extraction from muon scattering at MUSE using dispersively improved chiral effective field theory

The MUSE experiment at the Paul Scherrer Institute will measure low-energy muon-proton elastic scattering (muon momenta: 115–210 MeV) to determine the proton charge radius. This talk discusses the prospects for extracting the radius using dispersively improved chiral effective field theory (DIχEFT), which connects the proton's charge distribution to the form factor behavior while allowing data up to $Q^2 \sim 0.1$ GeV^2 to be used. We examine the sensitivity of the μp cross section to the proton radius, theoretical uncertainties in the predictions, and the two-photon exchange correction. The optimal kinematics for radius extraction at MUSE are found at 210 MeV and $Q^2 \sim 0.05$-0.08 GeV^2. We compare muon and electron scattering in the same kinematics and provide predictions for both μp and ep cross sections as functions of the proton radius.

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