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Impact of NNLO QED vs. TPE corrections in lepton-proton scattering at MAMI

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McMule (Monte Carlo for Muons and other Leptons) is a powerful tool for fully differential higher-order QED calculations of scattering and decay processes involving leptons. It provides different type of observables such as cross-sections and branching ratios.
In this work, we use McMule to study the process of lepton-proton scattering up to and including next-to-next-to-leading order (NNLO) QED corrections. One important contribution at next-to-leading order (NLO) is the two-photon-exchange (TPE) correction, which is the main focus of this work. We present results for both elastic and inelastic TPE, including associated uncertainties, and compare their size to the subleading NNLO corrections. Finally, we make a comparison between the McMule prediction and older experimental data from electron-proton scattering experiments conducted in Mainz by the A1 collaboration.

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