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High-precision theoretical predictions for the MUonE experiment

The MUonE experiment proposes a novel *spacelike* determination of the hadronic leading-order contribution to the muon anomalous magnetic moment by measuring the running of the electromagnetic coupling, $\Delta\alpha_{had}(t)$, through high-precision μe elastic scattering at CERN. Achieving the target 10 ppm accuracy on the differential cross section requires a dedicated Monte Carlo event generator with complete NNLO corrections and an appropriate resummation procedure. In this poster we present the latest theoretical ingredients developed for MESMER, the reference MC tool for MUonE. We show the full NNLO pair contributions to μe scattering, the calculation of the $\mu e \rightarrow \mu e \pi^0$ channel, and the evaluation of real lepton-pair production from muon-nucleus interactions in the target. The numerical impact of each process on the relevant differential observables is quantified under realistic MUonE conditions. These results provide essential components for the extraction of $\Delta\alpha_{had}(t)$ and for assessing background systematics in the MUonE analysis.

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