

Lattice determination of the NLO HVP contributions to the muon $g-2$

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In this work, we present a full lattice computation for the NLO contribution to the HVP of the muon $g-2$. First, we study the time-momentum representation (TMR) of the three kernels needed to compute the three different NLO HVP diagrams, following the work of Balzani, Laporta and Passera. For the HO corrections including extra photon or lepton lines, we present an analytical series of expansions for small values of the Euclidian time and numerical series expansions for the large time values. The NLO diagram with two QCD insertions can be analytically solved and then expanded over different regions of the 2D Euclidian time plane. These results are then combined with lattice QCD simulations from 12 different CLS ensembles employing Wilson quarks to obtain a full determination of the sub-leading hadronic contribution to the muon $g-2$. We apply two different $O(a)$ improvement programmes with two discretizations each to better constrain the continuum limit. On top of that, the Hansen-Patella method has been applied to correct for the finite volume effects. Finally, we perform a chiral and continuum extrapolation to the physical point obtaining a total estimation of the $a_\mu^{\text{hVP}}[\text{NLO}]$.

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