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The muon anomalous magnetic moment with staggered fermions: is the lattice spacing small enough?

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We present new results for the light-quark connected part of the leading order hadronic-vacuum-polarization (HVP) contribution to the muon anomalous magnetic moment, using staggered fermions. We have collected more statistics on previous ensembles, and we added two new ensembles. This allows us to reduce statistical errors on the HVP contribution and related window quantities significantly. We also calculated the current-current correlator to next-to-next-to-leading order (NNLO) in staggered chiral perturbation theory, so that we can correct to NNLO for finite-volume, pion-mass mistuning and taste-breaking effects. We discuss the applicability of NNLO chiral perturbation theory, emphasizing that it provides a systematic EFT approach to the HVP contribution, but not to short- or intermediate-distance window quantities. This makes it difficult to assess systematic errors on the standard intermediate-distance window quantity that is now widely considered in the literature. In view of this, we investigate a longer-distance window, for which EFT methods should be more reliable. Our most important conclusion is that new high-statistics computations at lattice spacings significantly smaller than 0.06 fm are indispensable. The ensembles we use have been generously provided by MILC and CalLat.

Primary authors: Prof. AUBIN, Christopher (Fordham University); GOLTERMAN, Maarten (San Francisco State University); Prof. PERIS, Santiago (Universtitat Autonomia de Barcelona); Prof. BLUM, Thomas (University of Connecticut)

Presenter: GOLTERMAN, Maarten (San Francisco State University)

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