Lepton anomalous magnetic moments from twisted mass fermions

Florian Burger\textsuperscript{1}, Grit Hotzel\textsuperscript{1}, Karl Jansen\textsuperscript{2}, Marcus Petschlies\textsuperscript{3}

\textsuperscript{1}Humboldt-Universität zu Berlin, Institut für Physik, D-12489 Berlin, Germany
\textsuperscript{2}John von Neumann Institute for Computing (NIC), DESY, Platanenallee 6, D-15738 Zeuthen, Germany
\textsuperscript{3}The Cyprus Institute, P.O. Box 27456, 1645 Nicosia, Cyprus

Introduction

The muon anomalous magnetic moment constitutes a prime candidate to possibly detect new physics beyond the standard model, since a 3 to 4 standard deviations discrepancy has been observed between its experimental and theoretical values. The dominant uncertainty originates from its hadronic contributions. Here, we show our results for the four-flavour leading hadronic contributions to the anomalous magnetic moments of all three leptons, being sensitive to very different momentum regions. Additionally, we confirm the results of our earlier chiral extrapolations by computing the light-quark contributions at the physical point. Furthermore, our attempts to reduce remaining systematic as well as statistical errors are described by showing the status of investigations of disconnected contributions, different fitting strategies, and the all-mode-averaging technique.

Basic Equations

leading hadronic contribution: $\delta_{\text{had}}(Q^2) = \delta_{\text{conn}}(Q^2) + \delta_{\text{disconn}}(Q^2)$

vacuum polarisation determined from correlator of point-split vector currents at source and sink

$N_f = 2 + 1 + 1$ fermions

continuum limit performed chiral extrapolation with improved definition analysis as described in \cite{1} using M1N2B4C1 fits

Disconnected contributions obtained with point-split vector currents at source and sink tried: estimating both loops stochastically with volume sources computing source loop exactly and using volume sources only for the other one due to large fluctuations no $Q^2$ dependence visible

All-mode-averaging

$N_f = 2$ fermions at the physical point

Comparison of MN fits and Padé fits in low-momentum region perform correlated Padé fits & uncorrelated MN fits (strong curvature of vacuum polarisation towards zero momentum) up to $Q^2_{\text{phys}} = 0.75 \text{ GeV}^2$

Comparison of light-quark contributions

results at physical point obtained with standard definition and same analysis as in \cite{1} using M1N2B4C1 fits due to higher statistics

Conclusions

anomalous magnetic moments of all three leptons compatible with phenomenological values

no signal for disconnected contributions found so far

computations at physical point confirm results from chiral extrapolations with improved definition

different analysis strategies and all-mode-averaging at physical point under examination

References

\cite{8} T. Blum, T. Inabeuchi and E. Shuntani, Phys. Rev. D88 (2013) 9 - 094503