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Precise determination of the low-energy hadronic contribution to the muon g–2 from analyticity and unitarity - an improved analysis

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Summary

The two-pion low-energy contribution to the anomalous magnetic moment of the muon, $a_\mu \equiv (g-2)_\mu/2$, expressed as an integral over the modulus squared of the pion electromagnetic form factor, brings a relatively large contribution to the theoretical error, since the low accuracy of experimental measurements in this region is amplified by the drastic increase of the integration kernel. We derive stringent constraints on the two-pion contribution by exploiting analyticity and unitarity of the pion electromagnetic form factor. To avoid the poor knowledge of the modulus of this function, we use instead its phase, known with high precision in the elastic region from Roy equations for pion-pion scattering via the Fermi-Watson theorem. Above the inelastic threshold we adopt a conservative integral condition on the modulus, determined from data and perturbative QCD. Additional high precision data on the modulus in the range $0.65 - 0.71$ GeV, obtained from e^+e^- annihilation and τ-decay experiments, are used to improve the predictions on the modulus
at lower energies by means of a parametrization-free analytic extrapolation. The results are optimal for a given input and do not depend on the unknown phase of the form factor above the inelastic threshold. The present work improves a previous analysis based on the same technique, including more experimental data and employing better statistical tools for their treatment. We obtain for the contribution to a_μ from below 0.63 GeV the value $(133.258 \pm 0.723) \times 10^{-10}$, which amounts to a reduction of the theoretical error by about 6×10^{-11}.

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