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Renormalons in the QCD spectral function, experimental data, and potential implications to the muon g-2

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The muon anomalous magnetic moment, $g-2$, is one of the most precisely measured quantities in physics. On the theoretical side, however, the Standard Model (SM) prediction does not achieve the same level of precision, primarily due to the uncertainty in the hadronic vacuum polarization (HVP) contribution. At energies between 2 and 3.7 GeV, perturbative QCD (pQCD) is often used for the prediction of the HVP contribution to $g-2$ and this method relies on the determination of the celebrated observable $R(s)$, or, equivalently, the spectral function. Recently, a discrepancy has been observed between the latest and more precise BES-III data and the pQCD prediction for $R(s)$. In order to investigate the origin of this tension, it is essential to analyze the spectral function in detail. In this work, we examine the perturbative series of the spectral function both in the so-called large-β_0 limit and in full QCD at different energy scales. We explore the potential implications of their renormalon structure on the spectral function's behavior, which directly impacts $R(s)$ and, consequently, the HVP contribution to $g-2$ (denoted as a_μ^{HVP}). Additionally, we present our preliminary results for the calculation of a_μ^{HVP} between 2-3GeV using a data-driven approach, along with a comparison to the pQCD prediction.

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