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Reduction of discretisation artifacts in the lattice subtraction function calculation

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The Compton amplitude subtraction function holds considerable phenomenological significance, evidenced by its role in the determination of such quantities as the proton-neutron mass difference. However, the subtraction function cannot be measured directly in experiments. While the subtraction function can be evaluated theoretically in the low-energy region using effective field theory, and in the high-energy region using the Operator Product Expansion (OPE), it's behaviour in the intermediate region is not well understood. Thus, the determination of the subtraction function from first principles is of substantial interest. Here, we use the Feynman-Hellmann (FH) method to perform the first lattice QCD calculation of this subtraction function over the approximate range $Q^2 \in [0.5, 12]$ GeV^2, with a particular focus on controlling the discretisation artifacts inherent in the calculation, thereby reducing a major source of systematic error. We extend previous work by performing a lattice OPE with non-zero mass, enabling us to quantify and remove the leading discretization artifacts in the FH results. In conjunction with the FH results, this work paves the way for model-independent and precise determinations of the subtraction function.

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