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The momentum sum rule via the Feynman Hellmann theorem

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Determining the quark and gluon contributions to the momentum of a hadron is a difficult and computationally expensive problem. This difficulty mainly arises from the calculation of the gluon matrix element which involves a quark-line disconnected gluon operator, which suffers from noisy ultra-violet fluctuations. Furthermore, a complete calculation also requires a determination of the non-perturbative renormalisation of this operator. In this work, we performed a quenched QCD study of the fully-renormalised quark and gluon contributions to the pion and nucleon momenta via an adaption of the Feynman-Hellmann technique. We find the momentum sum rules are satisfied within our uncertainties for both the pion and nucleon for 3 different values of the quark masses. We also discuss some recent progress on extending this procedure to a dynamical simulations.

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