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Renormalisation of quark and gluon operators using Feynman-Hellmann

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The decomposition of energy and momentum in the hadron in terms of quark and gluon constituents is of fundamental importance to hadron structure, and with the ongoing development of the future Electron-Ion Collider, there is tremendous interest in imaging the transverse distributions of these constituents. This program will be strengthened by complimentary studies in Lattice QCD, where a renormalisation of the lattice operators is necessary to connect the calculated distributions to the corresponding phenomenological quantities reported in a familiar renormalisation scheme, such as MS-bar. In such a renormalisation scheme, the quark and gluon operators mix under renormalisation. In literature it has been common to obtain the off-diagonal renormalisation factors through perturbation theory. However, for consistency, a fully non-perturbative renormalisation scheme that computes all components of the renormalisation matrix is desired. We will demonstrate an RI-MOM renormalisation scheme that includes mixed quark and gluon amputated vertex functions, to directly compute the mixing renormalisation factors. The method utilised exploits Feynman-Hellmann techniques to overcome troublesome statistical noise associated with singlet operators. The current demonstration is performed in the quenched approximation, with a straightforward generalisation to the dynamical case to be considered in near-future work.

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