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Step scaling in X-space: running of the quark mass

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We perform a benchmark study of the step scaling procedure for the ratios of renormalization constants extracted from position space correlation functions. We work in the quenched approximation and consider the pseudoscalar, scalar, vector and axial vector bilinears. The pseudoscalar/scalar cases allow us to obtain the non-perturbative running of the quark mass over a wide range of energy scales - from around 15 GeV to nearly 1 GeV - which agrees well with the 4-loop prediction of continuum perturbation theory. We find that step scaling is feasible in X-space and we discuss its advantages and potential problems.

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