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Probing QCD perturbation theory at high energies with continuum extrapolated lattice data

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A collaborative effort to determine the Λ-parameter in 3-flavour
QCD by the ALPHA collaboration has just been finalized. This requires the precise
connection of vastly different energy scales, which is achieved using suitable
running couplings in finite volume renormalization schemes and recursive step-scaling methods.
In this talk I focus on the scale evolution from an intermediate scale, $1/L_0$, of
about 4 GeV to scales of O(100) GeV. We use a 1-parameter family
of Schroedinger Functional (SF) couplings which are also very
well-suited for perturbation theory. In particular, their Λ-parameters
can be related exactly and
their respective β-functions are known to 3-loop order.
Our precise continuum extrapolated lattice data allows
for stringent tests of renormalized perturbation theory in the high energy regime.
and leads to a determination of the Λ-parameter (in units of L_0) with
a total error below 3 percent. To quote such a small error with confidence,
non-perturbative data is required around $\alpha_s = 0.1$.
In particular, our study suggests that the apparent precision
reached with data around $\alpha_s = 0.2$ can be misleading.

(cf. talk by M. Dalla Brida for the determination of L_0 in physical units)

Summary

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