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Hyperasymptotic approximation to the mass of the lightest gluelump

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Content

We present updated determinations of the leading renormalon normalizations associated with several key QCD quantities: the pole mass, the singlet and octet static potentials, and the gluelump energy, for both $n_f = 0$ and $n_f = 3$ light quark flavors. From these, we obtain two independent, renormalization-group-invariant and renormalization-scale-independent determinations of the energy of the lowest gluelump in the principal value (PV) summation scheme: $L_B^{PV} = 2.47(9)\, r_0^{-1}$, $L_B^{PV} = 2.38(11)\, r_0^{-1}$, which combine to give $L_B^{PV} = 2.44(7)\, r_0^{-1}$,in the quenched approximation ($r_0^{-1} \approx 400\,\text{MeV}$).

Our analysis employs hyperasymptotic expansion techniques to consistently treat renormalon ambiguities without introducing infrared cutoffs, leading to exponentially accurate definitions of the gluelump and hybrid static energies. These results provide the most precise quantitative link to date between perturbative and nonperturbative regimes in QCD and offer a benchmark for future lattice and EFT studies of hybrid and gluonic bound states.

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