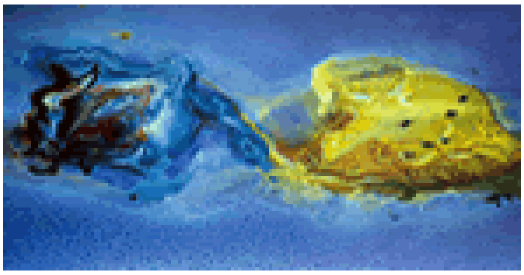

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Cornell Model calibration with NRQCD at N3LO

Thursday, 2 August 2018 15:40 (20 minutes)

The typical energy scale of heavy hadron spectroscopy makes the system accessible to perturbative calculations in terms of non-relativistic QCD. Within NRQCD the predictions of heavy quarkonium energy levels rely on the accurate description of the static QCD potential $V_{\rm QCD}(r)$. Most recent calculations computed the energy levels of the lower-lying bottomonium states up to $\mathcal{O}(\alpha_s^5 m)$ and $\mathcal{O}(\alpha_s^5 m \log\alpha_s)$ utilizing pNRQCD [1]. A closed expression for arbitrary quantum numbers can be found in Ref [2].

Historically, the heavy quarkonium spectroscopy was study using phenomenological approaches such as the Cornell model $V_{\rm Cornell} = -\kappa/r + \sigma r$, which assumes a short-distance dominant Coulomb potential plus a liner rising potential that emerges at long distances. Such model works satisfactorily in describing the charmonium and bottomonium spectroscopy. However, even when there are physically-motivated arguments for the construction of the Cornell model, there is no connection a priori between the model and QCD parameters.

Based on a previous work on heavy meson spectroscopy [3], we calibrate the Cornell model with NRQCD predictions for the lowest lying bottomonium states at N^{3}LO, in which the bottom mass is varied within a wide range. We show that the Cornell model mass parameter can be identified with the low-scale short-distance MSR mass at the scale $R = 1$ GeV. This identification holds for any value of α_s or the bottom mass. Furthermore we show that a) the "string tension"parameter is completely independent of the bottom mass, and b) the Coulomb strength κ of the Cornell model can be related to the QCD strong coupling constant α_s at a certain scale. Finally we show that for moderate values of r, the NRQCD and Cornell static potentials are in head-on agreement when switching the pole mass to the MSR scheme, which allows to simultaneously cancel the renormalon and sum up large logarithms.

[1] N. Brambilla, A. Pineda, J. Soto and A. Vairo, Nucl. Phys. B 566, 275 (2000).

[2] Y. Kiyo and Y. Sumino, Nucl. Phys. B 889, 156 (2014).

[3] V. Mateu and P. G.˜Ortega, JHEP 1801 (2018) 122.

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