Problem set 10

Problem 1

- Determine the value of Λ_{QCD} for three fermions ($N_f = 3$), knowing that the strong coupling constant has been measured at the Z^0 mass: $\alpha_s(M_Z) = 0.12$.

- Compute the strong potential energy (binding energy) for the mesons ϕ ($s\bar{s}$), J/Ψ ($c\bar{c}$) and $\Upsilon(1S)$ ($b\bar{b}$), for which $m_\phi = 1020\,\mathrm{MeV}$, $m_{J/\Psi} = 3100\,\mathrm{MeV}$, and $m_\Upsilon = 9500\,\mathrm{MeV}$. Assume the typical radius of the meson to be of order 1 fm.

Problem 2

Show that the number of degrees of freedom for

- all the quarks and gluons is 79.

- all the particles of the standard model (quarks, leptons, gauge bosons, Higgs boson) is 106.75.