

Exercise – The Coleman-Weinberg potential

Show that when expressed in terms of the renormalized coupling λ_R , the 1-loop corrected effective potential in $\lambda\phi^4$ -scalar field theory takes the form

$$V_{\text{eff}}(\phi_{\text{cl}}) = \frac{1}{4!} \phi_{\text{cl}}^4 \left\{ \lambda_R + \frac{3\lambda_R^2}{32\pi^2} \left(\ln \frac{\phi_{\text{cl}}^2}{M^2} - \frac{25}{6} \right) \right\} .$$

This is the Coleman-Weinberg potential. Show that it is form invariant under changes of scale, provided λ_R is changed accordingly.