Quantum Field Theory 2 – Tutorial 13

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Problem 1: Wilson-Fisher Fixed Point

Consider a scalar field theory in 3 dimension, with a quartic interaction $\frac{1}{4!}\lambda\phi^4$. The beta function of the coupling λ in this case is given by:

$$\Lambda\frac{\mathrm{d}}{\mathrm{d}\Lambda}\lambda = \beta_\lambda = -\lambda + \frac{3\lambda^2}{16\pi^2} + \mathcal{O}(\lambda^3).$$

Show that for a particular value of the coupling λ_* the beta function vanish $\beta(\lambda_*) = 0$. This particular value of the coupling is called fixed point.
Describe the behavior of the coupling in the UV ($\Lambda \to \infty$) and in the IR ($\Lambda \to 0$) with plotting the $\beta(\lambda)$ and indicating the RG-flow.