

Physics 722, Spring 2016

Problem Set 2, due Thursday, Feb 11.

Consider the theory of a real scalar field coupled to a Dirac spinor field,

$$\mathcal{L} = \frac{1}{2}(\partial_\mu\phi)^2 - \frac{\mu^2}{2}\phi^2 + \bar{\psi}(i\not{\partial} - m)\psi - g\bar{\psi}\psi\phi - \frac{g_3}{3!}\phi^3 - \frac{g_4}{4!}\phi^4 + \text{counterterms}.$$

Calculate the one-loop renormalized self energy $\widetilde{\Pi}(k^2)$ for the scalar field ϕ . $\widetilde{\Pi}(k^2)$ should satisfy the renormalization conditions $\widetilde{\Pi}(\mu^2) = 0$ and $d\widetilde{\Pi}/dk^2|_{k^2=\mu^2} = 0$. Your result should be left in terms of integrals over a single Feynman parameter.