

Physics 613 Homework #9

Due April 14, 2014 at 4:00 EST

- 1:** Consider the quantum field theory of a complex spinor ψ with mass m coupled to a neutral scalar field ϕ of mass μ , with a scalar-spinor interaction $-q\bar{\psi}\psi\phi$ and a scalar self-interaction $-\frac{\lambda}{4!}\phi^4$
1. Is this a renormalizable theory? Which products of fields might require regularization? How divergent is each expected to be?
 2. Write out the lowest order correction to the scalar propagator due to intermediate spinors. Do we have divergent $\delta\mu^2$ and divergent field strength Z_μ with $\phi = Z_\mu^{-1/2}\phi_0$? Give the expression for $\Pi_\mu^{[2]}$, without worrying about regularization.
 3. Write out the lowest order correction to the spinor propagator due to an intermediate spinor-scalar state. Do we have divergent δm and divergent field strength $Z_{2,\psi}$ with $\psi = Z_{2,\psi}^{-1/2}\psi_0$? Let $\Sigma^{[2]}(p)$ be the analog of $\Pi_\mu^{[2]}$ for the spinor. Note that it is a matrix in spinor space. Give an expression for it, again without worrying about regularization.