

Physics 215A QFT Fall 2016 Assignment 6

Due 11am Thursday, November 10, 2016

1. Propagator corrections in a solvable field theory.

Consider a theory of a scalar field in D dimensions with action

$$S = S_0 + S_1$$

where

$$S_0 = \int d^D x \frac{1}{2} (\partial_\mu \phi \partial^\mu \phi - m_0^2 \phi^2)$$

and

$$S_1 = - \int d^D x \frac{1}{2} \delta m^2 \phi^2 .$$

We have artificially decomposed the mass term into two parts. We will do perturbation theory in small δm^2 , treating S_1 as an ‘interaction’ term. We wish to show that the organization of perturbation theory that we’ve seen lecture will correctly reassemble the mass term.

- (a) Write down all the Feynman rules for this perturbation theory.
- (b) Determine the 1PI two-point function in this model, defined by

$$i\Sigma \equiv \sum (\text{all 1PI diagrams with two nubbins}) .$$

- (c) Show that the (geometric) summation of the propagator corrections correctly produces the propagator that you would have used had we not split up $m_0^2 + \delta m^2$.

2. Particle creation by an external source.

Peskin, problem 4.1. Compare this problem with the problem on the previous problem set.

3. Decay of a scalar particle.

Peskin, problem 4.2