

QFT — Scalar Quantum Electrodynamics: assignment 9

1. sQED Lagrangian

Construct the full Lagrangian density for gauged scalars. I.e, couple a charged Klein-Gordon field to photons. Don't forget the F^2 and gauge fixing terms.

2. Feynman Rules

Write the propagators and vertices for the theory. (NB: there are problems when deriving Feynman rules for momentum-dependent interactions. Ignore these; they can be shown to go away).

3. 'Compton' Scattering Amplitude

Write the invariant amplitude for 'Compton' scattering. Do not set $k \cdot \epsilon(k) = 0$ in your expression.

4. Gauge Invariance

Check gauge invariance of your amplitude (see the discussion on pg 145 in Mandl and Shaw).

5. Compton Scattering Cross Section

Compute the unpolarised differential cross section in the centre of mass frame in the relativistic limit (this means that you can ignore the scalar mass).

6. Renormalisation

- (i) Carefully enumerate the divergent diagrams of the theory.
- (ii) Write all the counterterms required. Is the theory renormalisable?
- (iii) Is $\mathcal{L}_{phys} + \mathcal{L}_{c.t.}$ gauge invariant?