Physics 721, Fall 2005Problem Set 7: Scattering amplitudesDue Tuesday, November 8.

1. Practice with Feynman diagrams

Using the Feynman rules for the meson-nucleon theory, write down the scattering amplitudes for $N+\overline{N} \rightarrow N+\overline{N}$ and $N+\overline{N} \rightarrow \phi + \phi$ scattering at $\mathcal{O}(g^2)$.

Similarly, write down the scattering amplitude for $\phi + \phi \rightarrow \phi + \phi$ scattering at $\mathcal{O}(g^4)$.

Be careful to include all diagrams that contribute to each process at the given order in g, and label all the external momenta and spins where relevant.

2. Generalized meson-nucleon interactions

The Lagrangian density for a generalized meson-nucleon theory is,

$$\mathcal{L} = \frac{1}{2} (\partial_{\mu} \phi)^2 - \frac{\mu^2}{2} \phi^2 + \overline{\psi} (i\partial \!\!\!/ - m) \psi - g \,\overline{\psi} (a + ib\gamma^5) \psi \phi,$$

with real constants a and b.

What are the Feynman rules for this theory, i.e. the vertices, propagators and external lines?