

215a Homework exercises 4, Fall 2019, due Nov. 4

1. Suppose that we modified our nucleon + meson model by adding $\Delta\mathcal{L}_{int} = g'\phi\psi\psi + g'\phi\psi^\dagger\psi^\dagger$, and do a perturbative expansion in both g and g' .

(a) Draw the new Feynman diagram interaction vertices associated with g' . As in class, use dotted lines to represent ϕ and directed arrow lines to represent ψ and ψ^\dagger . The g' interaction violates the previously conserved nucleon number, so the associated vertices can act as a net source or sink for arrows.

(b) Consider $N(p_1) + N(p_2) \rightarrow N(q_1) + N(q_2)$. Show that $g' \neq 0$ allows for an s -channel diagram. Draw the diagram and give its contribution to the scattering amplitude, to leading non-zero order.

2. Compute the CM frame differential cross section $d\sigma/d\Omega$ for $N + \bar{N} \rightarrow \phi + \phi$ in the toy model of mesons (mass μ) and nucleons (mass m) at tree-level (i.e. leading order in perturbation theory). Write the answer in terms of E_{CM} and θ .
3. Similar to the previous exercise, but for $N + \phi \rightarrow N + \phi$.