

Homework 9: Due November 10

1. Scattering in quantum mechanics depends on the various quantum numbers of the states involved. For strongly interacting particle this includes isospin. Suppose one knows the proton-proton scattering amplitude (for our purposes it doesn't matter what the scattering amplitude actually means in detail---however it tells us all we can know about a scattering process) Suppose further that we can argue that to very good approximation the scattering depends on physics which is isospin invariant---non-isospin conserving contributions (such as electromagnetic effects) can be neglected
 - a. Somebody claims that the neutron-neutron scattering amplitude should be identical to the proton-proton scattering amplitude (with all other quantum numbers such as spin the same). Are they right?. Hint: Determine the decomposition in to states with good I^2 and I_z for the proton-proton and neutron-neutron systems.
 - b. Somebody else claims that the proton-neutron scattering amplitude should be identical. Are they right? Hint: Determine the decomposition of a proton-neutron state into states with good I^2 and I_z for the proton-neutron systems.
2. This problem also concerns isospin. There is a baryon called the $\Delta(1700)$. It is an isospin $3/2$ state meaning it has 4 different charge states $++$, $+$, 0 , $-$. Suppose one has a reaction which creates the charge $+$ state. It can decay in various ways.
 - a. One possible decay is into a Δ (isospin $3/2$) and a pion (isospin 1). What is the relative probability that the final state is : $\Delta^{++} + \pi^-$, $\Delta^+ + \pi^0$ or $\Delta^0 + \pi^+$?
 - b. Another possible decay is into a nucleon (isospin $1/2$) and a pion: What is the relative probability that the final state is : $p + \pi^0$ or $n + \pi^+$.

Sakurai: Chapter 3: 15, 16, 18, 19, 21