INTRODUCTION TO NUCLEAR AND PARTICLE PHYSICS
Homework Set 10
April 27, 2016

1. Consider the weak decay, $K^+ \to \pi^+ + \pi^0$. What is the orbital angular momentum L for the final-state pions? Show that parity is not conserved in this decay. Show that strangeness is also not conserved, but that the change in strangeness satisfies the selection rule, $|\Delta S| = 1$. Show that I_3 is not conserved, but that the selection rule, $|\Delta I_3| = 1/2$, is satisfied.

2. In an electron-positron colliding-beam experiment, several events of the type $e^+ + e^- \to M \to 2\eta$ are identified. If the η-mesons result from the strong decay of an intermediate meson M, determine its allowed values of J^P, total isospin I, and C-parity.

3. Analyze in detail each of the following decays to explain why they have not been observed experimentally. Some of the decays may occur very rarely; others are absolutely forbidden. Indicate *how* the decay most likely occurs if it may occur; otherwise, note that the decay is absolutely forbidden.

   (a) $\eta \to \pi^0 \pi^0$

   (b) $\omega \to \pi^0 \pi^0$

   (c) $\omega \to \eta \pi^0$

   Note that η and π^0 mesons have $J^{PC} = 0^{-+}$ but isospin $I = 0$ for the η whereas $I = 1$ for the π^0. The ω meson has $J^{PC} = 1^{--}$ and $I = 0$.